

Wiring

46 CPF. 111.60 requires that whenever a cable penetrates a steel bulkhead or deck, a minimum bearing surface of 114 inch must be provided. Normally, A- and 3-Class steel bulkheads are less than 114 inch in thickness, therefore an additional bearing surface is required. The generally accepted marine practice is to use steel or other ferrous stuffing tubes, figure 2.7.4. specific approval of stuffing tubes is not granted, however, they are evaluated for suitability during plan review at the Coast Guard district offices. If it is necessary to group together several cables for penetration of a division, an alternative to stuffing tubes is available in the form of multiple cable penetration devices. These devices are specifically approved by the Commandant for use in A-0 Class divisions. Approved multiple cable penetration devices and methods are listed in CG-293, Miscellaneous Electrical Equipment List.

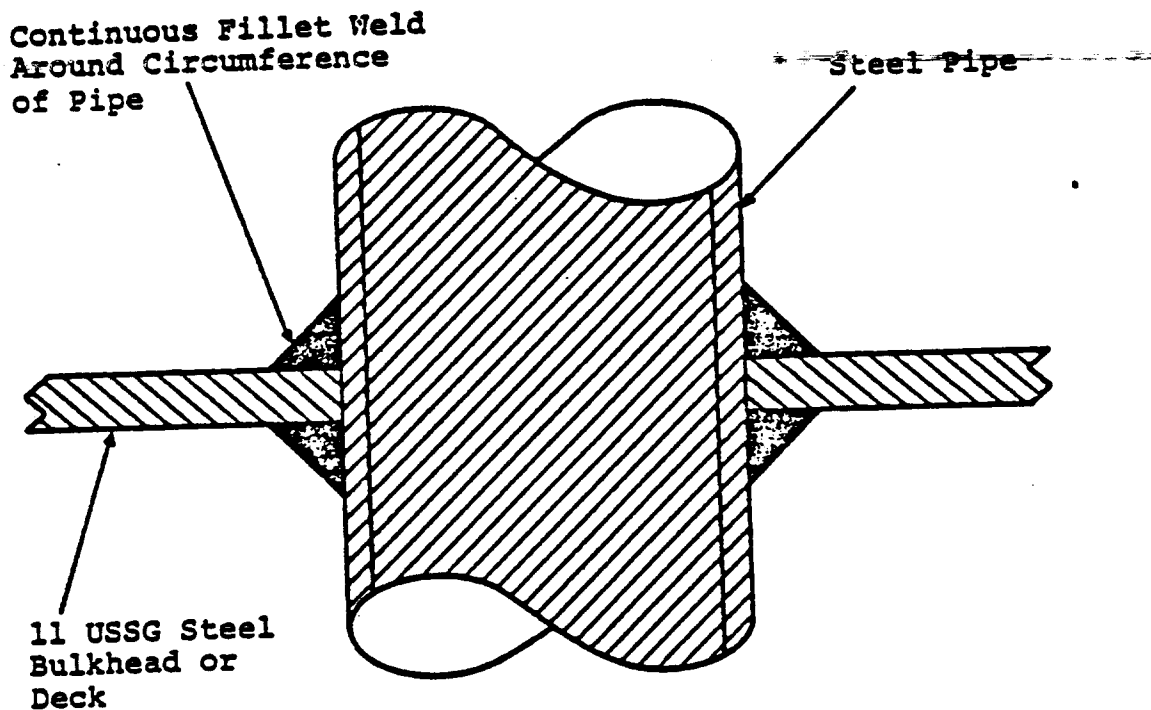


Figure 2.7.1-Typical Piping Penetration of A-Class Division

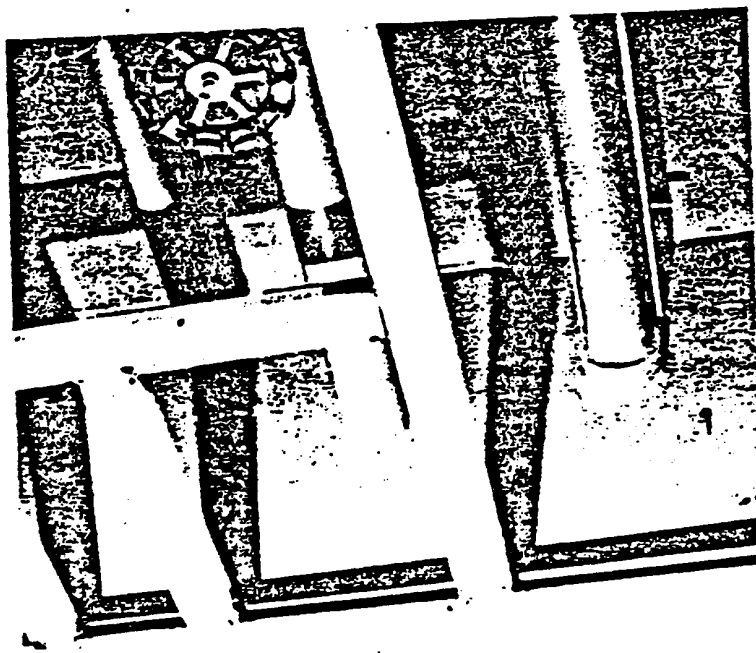
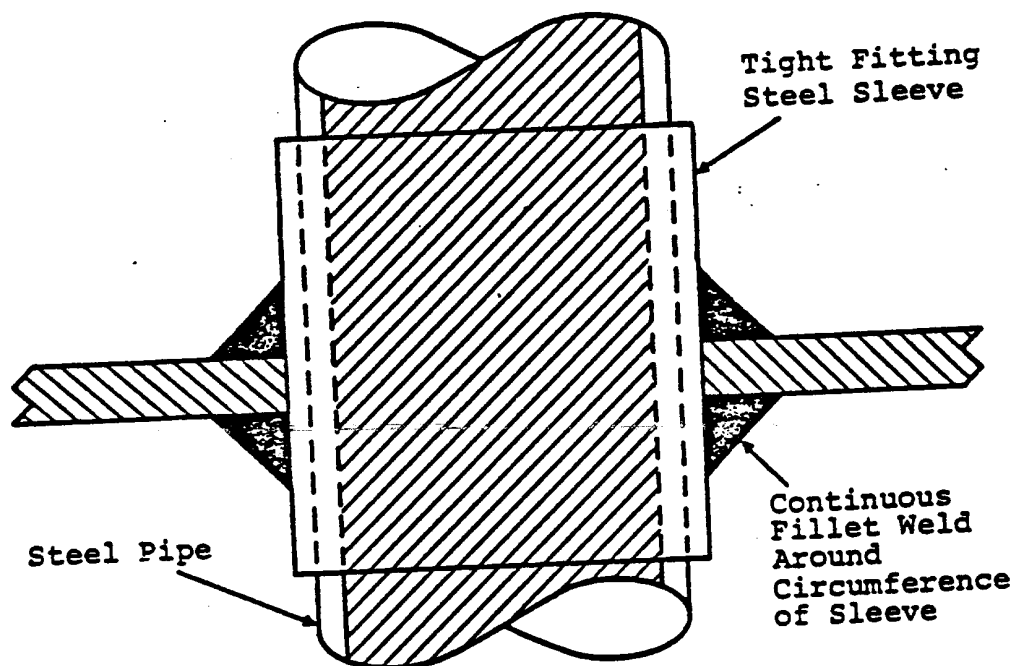


Figure 2.7.2-Typical Piping Penetration of A-Class Division Using Steel Sleeve Around Pipe

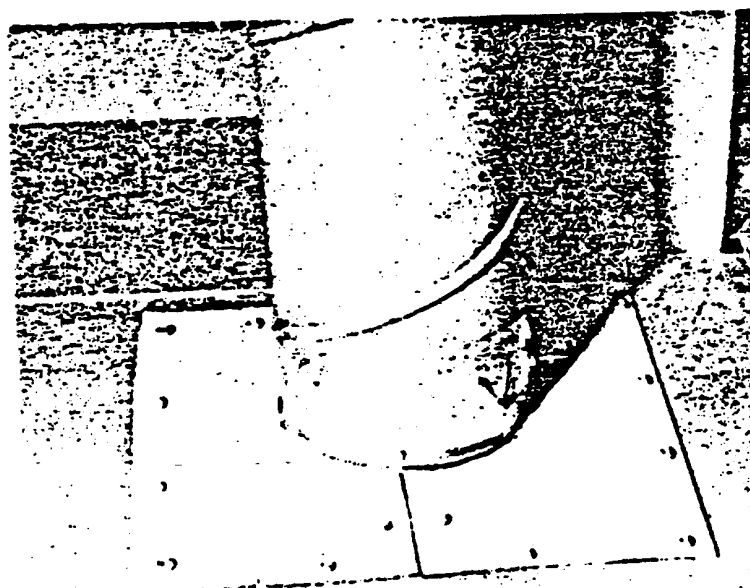
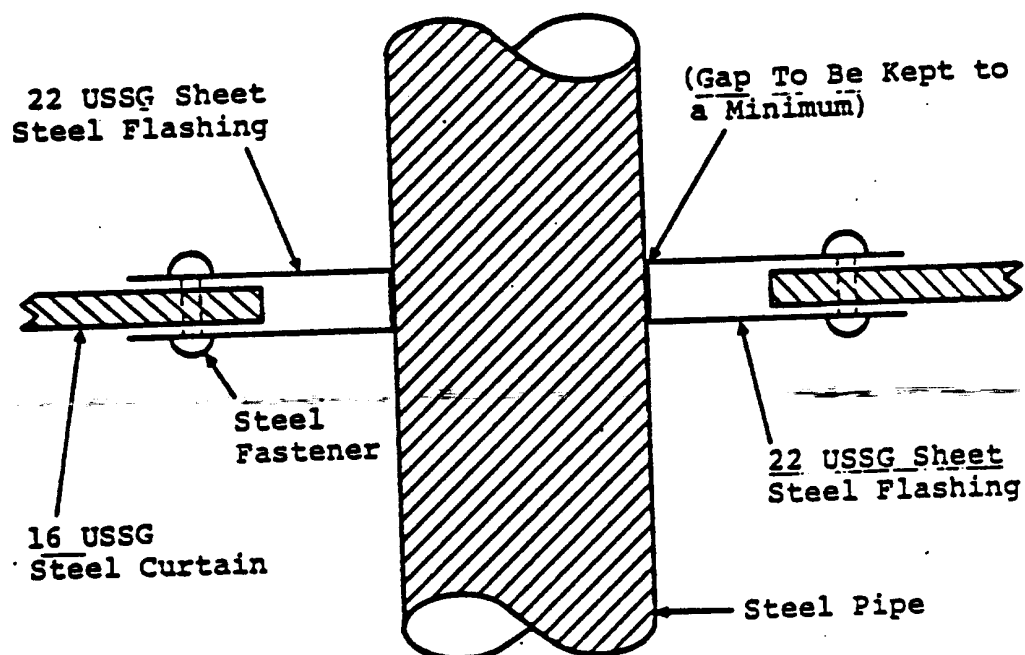


Figure 2.7.3-Typical Piping Penetration in Steel B-Class Corridor Bulkhead

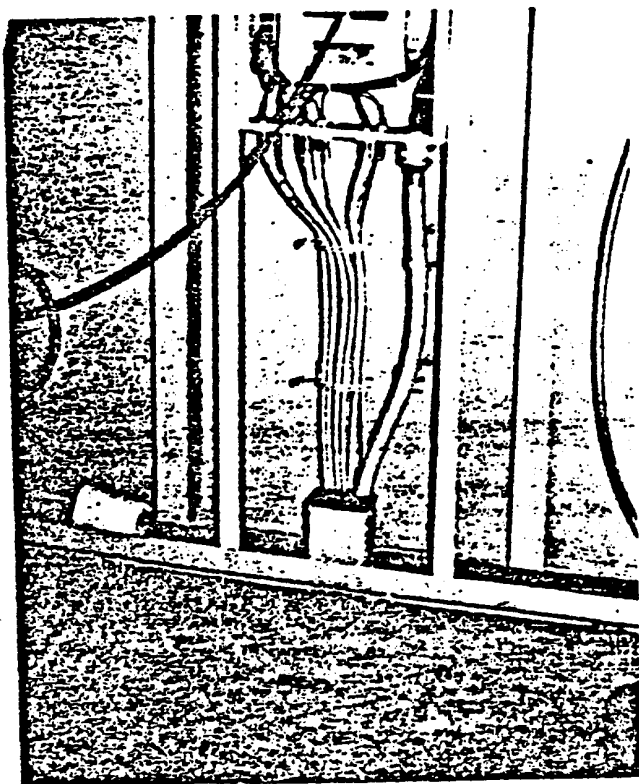
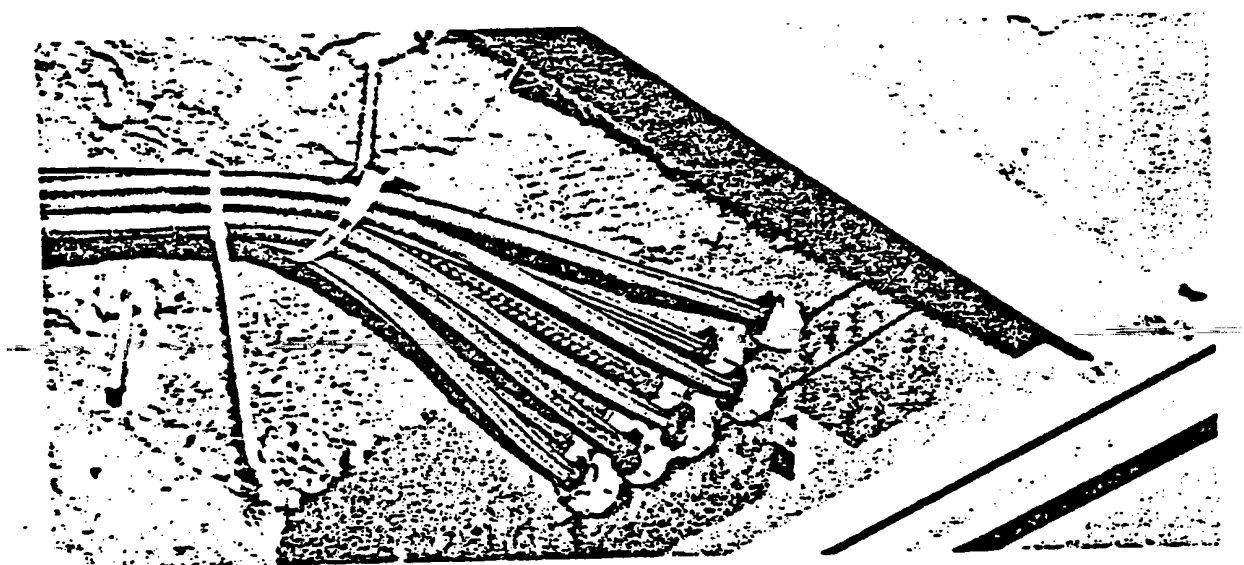


Figure 2.7.4-Typical Stuffing Tube Penetrations.

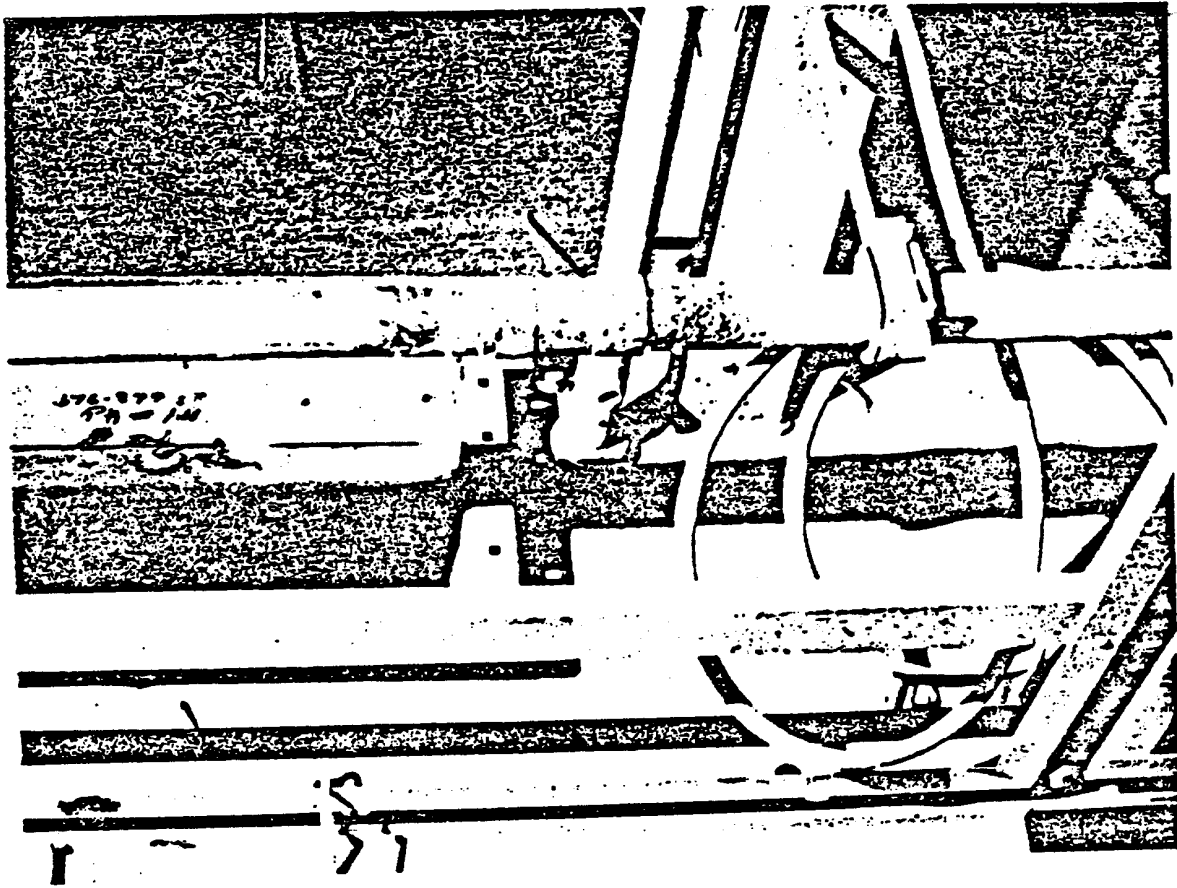


Figure 2.7.5-Flange Through Bulkhead for Ventilation Duct.

stuffing tubes and approved multiple cable penetration devices are only capable of meeting A-0 or B-0 Class requirements. If the division penetrated is required to be insulated, insulation approved in accordance with 116 CFR 1611.007 must be applied to the cable penetration, and at least 12 inches along the cable on the insulated side of the division.

Ducting

When ventilation ducting penetrates A- or B-Class divisions, adequate means must be provided to maintain the integrity of the division. Due to the requirements for fire dampers at penetrations (see Section 3.11), it is often desirable to arrange duct work so that a minimize number of bulkheads and decks are penetrated. Aboard passenger vessels, there are restrictions which prohibit stairway and stairtower ventilation systems from serving any other space. There is also a requirement that no duct may serve two main vertical zones.

Where steel ducts penetrate steel A- or 3-Class divisions, the duct should either be welded or flanged to the division, figure 2.7.5, or run through a tight-fitting sleeve. As with other penetrations, whenever ducts pass through insulated steel divisions, insulation approved in accordance with 46 CFR 164.007 is required on the duct for a distance of 12 inches from the division. Two exceptions to the 12-inch requirement exist (1) aboard passenger vessels - vertical ventilation ducts which serve cargo or main machinery spaces which pass through accommodations or safety areas must be insulated to the applicable bulkhead requirements for 6 feet beyond the division (46 CFR 72.05-50(g), and (2) aboard tank vessels - any ventilation duct which serves Category A machinery spaces that passes through accommodation, service, or control spaces must be constructed to A-60 Class requirements or constructed of steel, fitted with an automatic fire damper at each boundary where it enters and leaves the machinery space, and insulated to A-60 Class requirements for a distance of 5 meters (16.4 ft) beyond each machinery space boundary (46 CFR 32.56-60).

2.8 Doors

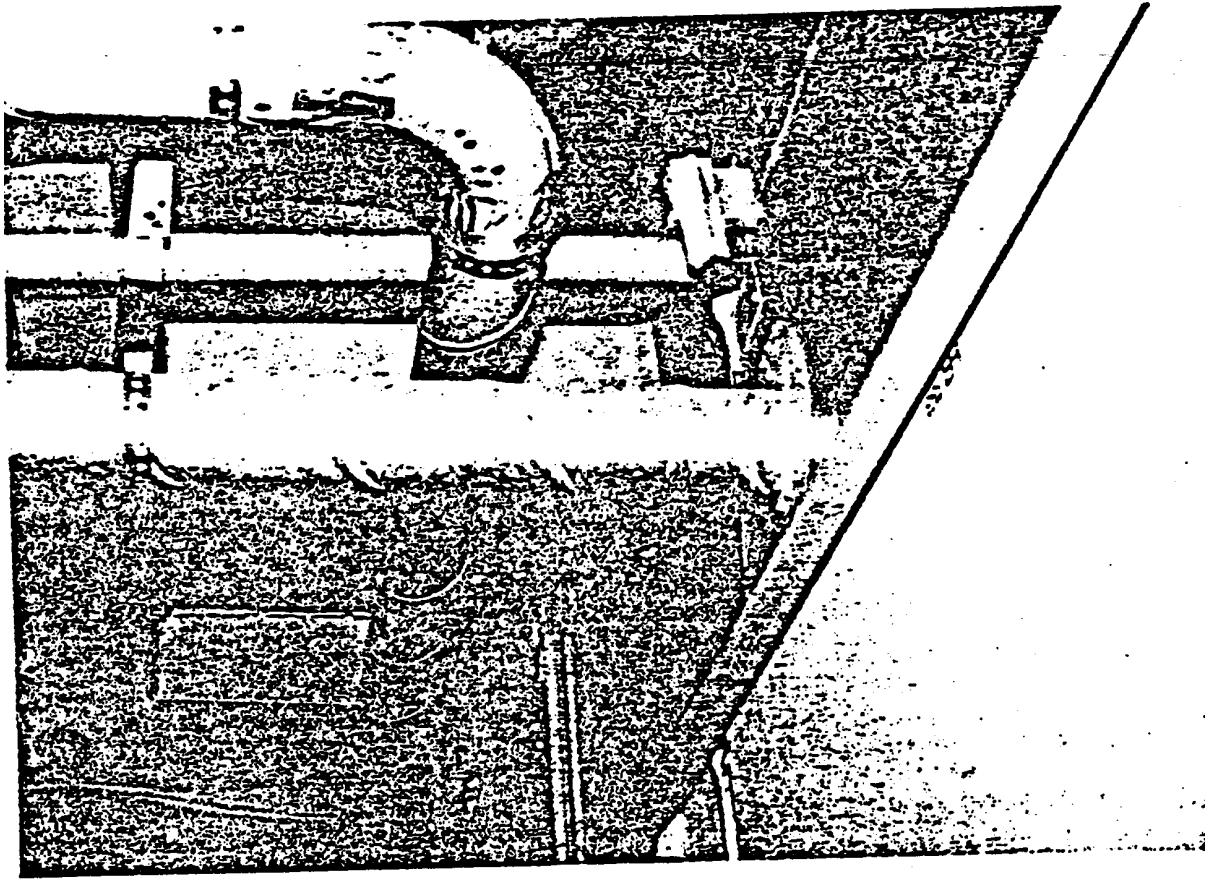
Unlike bulkheads and decks, doors are not required to meet any fire test requirements. It was felt that due to the limited amount of combustibles stowed adjacent to doors, and because doors must be capable of opening and closing, an equivalent amount of integrity could be provided by specifying construction requirements for doors. Most doors are constructed of steel, and in some cases they are also insulated with approved structural insulations. No specific requirements are listed for hardware such as hinges, frames, latches, and closers, but manufacturers, in general, use steel components similar to those tested by U.L.

For doors which are installed in A-Class bulkheads, the following general requirements exist:

- (1) The door must be of steel or equivalent metal construction. Generally, a double thickness of 16 USSG or a single thickness of 11 USSG is acceptable.
- (2) The doors must have a latch which can be operated from either side with a minimum throw of 3/4 inch.
- (3) The bottoms of the doors may be undercut, up to a maximum of 1/2 inch.
- (4) Door frames must provide a minimum of 1 1/2 inch door stop at the sides and top. However, only a 3/8" overlap of the door on the frames is considered necessary.
- (5) maximum of 100 square inches of wire-inserted glass may be installed in each door.
- (6) Vent grilles or louvers are prohibited in A-Class doors.

Double doors in A- or P-Class bulkheads must meet the following additional requirements:

- (1) Double doors capable of independent operation and latching may have a maximum gap between the doors of 1/8 inch. Doors which must be sequentially closed must have a 1/2 inch door stop or astragal strip mounted on the door which closes first.
- (2) Double swing doors may have a maximum gap of 1/8 inch at the top and sides.



Penetration of B-Class Corridor Bulkhead for Stateroom Ventilation.

Doors installed in stairways or main vertical zone bulkheads aboard passenger vessels must meet the following additional requirements.

- (1) Doors not normally locked must be self-closing and be capable of closing against a 3-1/2 degree list.
- (2) Doors may not be held open with holdback hooks. Magnetic holdbacks with remote control release on the bridge may be used.
- (3) Doors in main vertical zone bulkheads may not be fitted with hose ports.

Where doors are to be installed in 3-Class bulkheads, the following general requirements must be met:

- (1) Door must be of steel, hollow steel, or equivalent metal construction. A single thickness of 16 USSG steel or a double thickness of 22 USSG steel is acceptable. Approved non-combustible materials may be used if specifically approved by the Commandant. Aluminum doors may be used if fire tested and approved for specific locations by the Commandant.
- (2) All glass installed in B-Class doors must be wire-inserted glass.
- (3) B-Class doors may have a vent or louver in the lower half, not to exceed 2 square feet in area. This louver may be designed as a vertical duct within the door, which opens on the upper side of the door on the passageway side. This is to provide noise reduction in the stateroom.
- (4) The doors must have a latch capable of operation from either side with a minimum throw of 3/8 inch.
- (5) The doors may be undercut up to a maximum of 1 inch.
- (6) Door frames must provide a minimum 1/2 inch door stop on the sides and top; however, only a 3/8 inch overlap of the door on the frame is considered necessary.

Additional requirements for specific types of doors are as follows:

- (1) Doors for installation in A-60, A-30, and A-15 Class bulkheads must meet the requirements for A-Class doors and must also be filled with approved structural insulation. These doors need not be insulated to A-60 or A-30 standards, but require sufficient insulation to meet A-15 standards. One half of the thickness of structural insulation approved under 164.007 provides A-15 construction.
- (2) Doors opening onto weather decks may be aluminum, or oak or similar hardwood having a minimum thickness of 1-3/4 inch. This requirement applies only to doors on the side of superstructures which do not face the cargo area.
- (3) Doors to be installed in C-class bulkheads must be constructed of approved, non-combustible materials.

2.9. Tonnage Openings

Whenever tonnage openings are made in A-Class boundaries, they should be closed by steel plates of at least 11 USSG and held in place by steel hook bolts. No gaskets or caulking are permitted around the plate. Where tonnage openings are installed in A-15, A-30, or A-60 divisions, the cover plate should be insulated to the same standards as the division penetrated. Additional insulation is not considered necessary over the hook bolts; however, care should be taken to insure that the gap between the insulation on the division and the insulation on the cover plate is as small as possible.

2.10 Window: and Glass

Windows or portlights are generally constructed with bronze or steel frames, figure 2.10.1. Additionally, where external windows are fitted in joiner bulkheads, a 16 USSG steel casing, figure 2.10.2, should be provided to act as a fire barrier between the joiner bulkhead and the shell of the

vessel. Steel frames and steel glazing beads or angles to keep the glass in place are generally required in steel or other fire resistant bulkheads. 30th steel and glass are noncombustible and have high melting points. Use of frames such as: aluminum with a low melting point in an otherwise fire resistant bulkhead can only be accepted where steel retaining clips, connected to the bulkhead, support the glass in place if the frame melts away. Similarly, melting of frames or burning of combustible baskets should not leave large gaps which would permit passage of fire and smoke. For those areas where "wire inserted" glass is required, it should be noted that heat treated glass is not acceptable as a substitute. The minimum acceptable thickness for all glass is 1/4 inch. The maximum allowable spacing between wires in wire inserted glass is two inches. Section 5.0 contains specific requirements for Tank vessel superstructures.

3.0. Construction and Arrangement

The specific Coast Guard rules and regulations relating to the structural fire protection of vessels are contained in the Code of Federal Regulations under Title 46 -- Shipping. They have been subdivided as follows:

- (1) 46 CFR 30-40 (Subchapter D -- Tank Vessels)
- (2) 46 CFR 70-80 (Subchapter H -- Passenger Vessels)
- (3) 46 CFR 90-105 (Subchapter I -- Cargo and Miscellaneous Vessels)
- (4) 46 CFR 107-113 (Subchapter I-A -- Mobile Offshore Drilling Units)
- (5) 46 CFR 166-168 (subchapter R -- Nautical Schools)
- (6) 46 CFR 175-187 (Subchapter T -- Small passenger Vessels (Under 100 gross tons))
- (7) 46 CFR 188-196 (Subchapter U -- Oceanographic vessels)

The various subchapters may be purchased at nominal cost from the superintendent of Documents, U.S. Government printing office. Washington. D.C. 20402.

The structural fire protection regulations for all vessels have been developed from the original rules for passenger vessels. Many of the other subchapters are not as explicit as the passenger vessel rules. If there is a question of interpretation in one of these subchapters, it has been the policy of the Coast Guard to use 46 CFR subchapter H for guidance. Table 3.0 is a basic list of requirements for passenger, tank, and cargo vessels which provides a numerical reference to the appropriate regulations.

It is the intent of this guide to illustrate standard design features which have been accepted as "good marine practice" and interpretations which also comply with the intent of the regulations. The rules and regulations for cargo and tank vessels have been purposely written in fairly general terms to provide design flexibility.

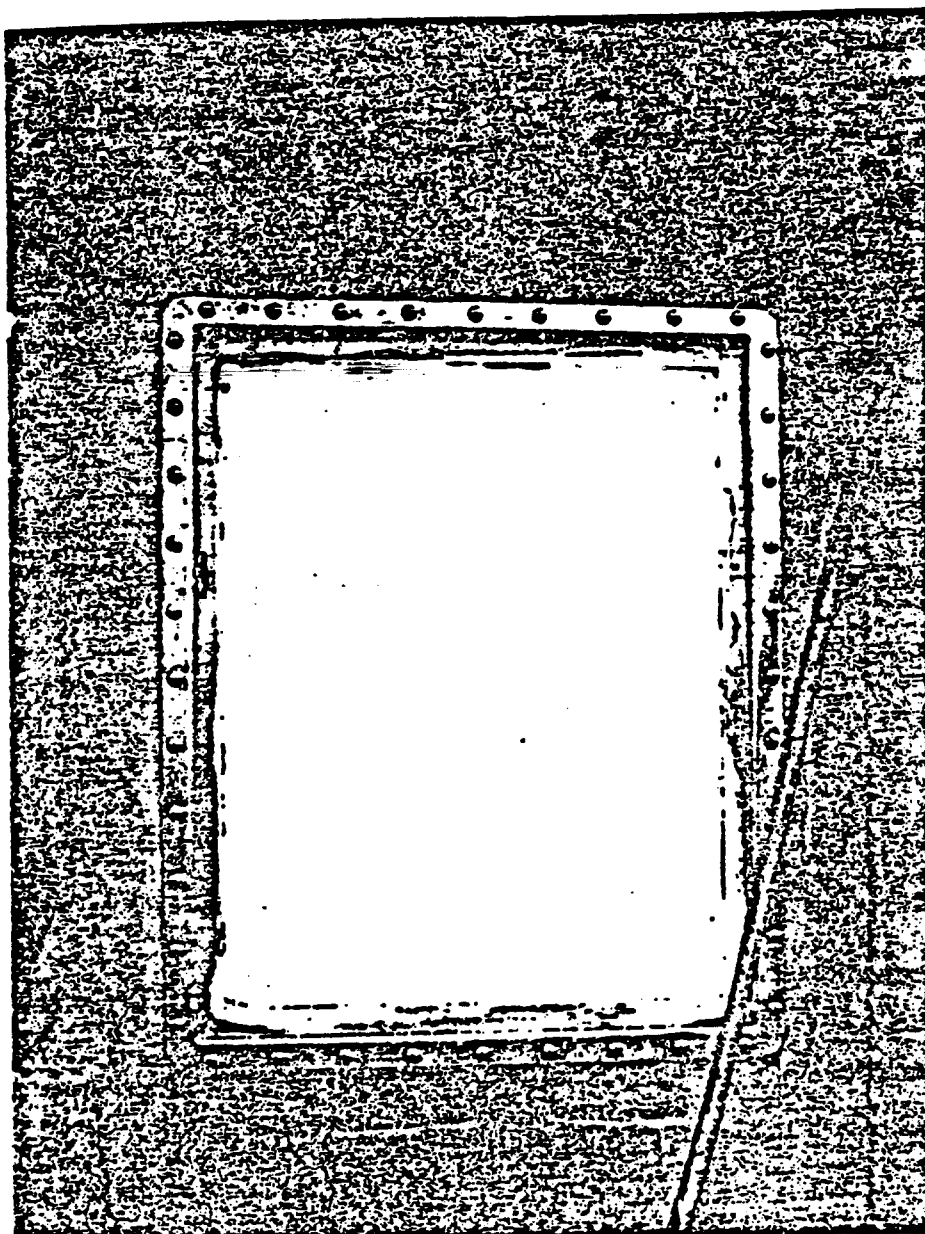


Figure 2.10.1-Typical Steel Window Frame.

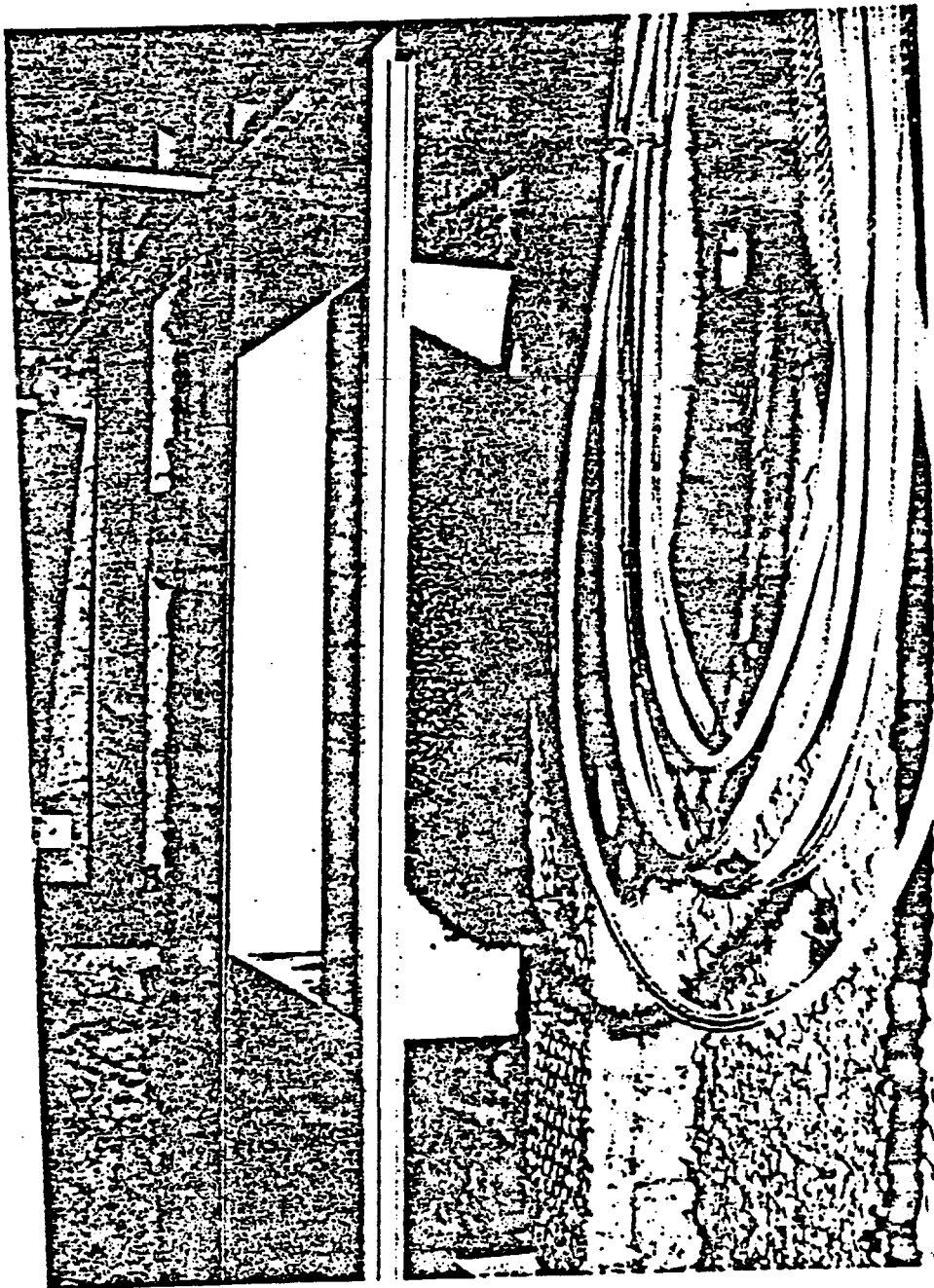


Figure 2.10.2-Typical Joiner Bulkhead Window Casing.

The specific vessel regulations should be consulted to determine the regulatory requirements prior to using this guide. This is of particular importance because the requirements for some vessels are more stringent than others.

3.1 Bulkheads.

When designing a vessel, it is beneficial to realize that the location of bulkheads may serve several purposes. primarily bulkheads are located to act as structural members and, secondly, they can be an element of the structural fire protection system. A shipboard fire can spread until some form of containment is met. If structural fire protection is not incorporated in the bulkheads of a compartment, the fire can burn freely, consuming the contents and bulkheads of the space and can move on to adjacent spaces. This process may continue until the available fuel supply is consumed; however, by such time, the vessel is generally lost. Structural fire protection boundaries provide containment to limit the spread of fire and, in some cases, smoke. These boundaries are designed to contain potential fires for a period of time which will allow the fuel load in the compartment to be consumed, causing self extinguishment of the fire; or for extinguishment to be effected by the fire control party. provisions are also made to insure against the spread of fire to adjacent compartments by preventing the conduction of heat into these spaces, which could ignite combustibles and cause the start of other fires. The degree of structural fire protection necessary to accomplish this task depends upon factors such as the type and amount of fuel available for combustion in the protected space and the contents of the adjacent spaces. Experience and full-scale testing have provided a realistic measure of fire-endurance requirements for bulkheads that are currently contained in the regulations.

A-Class Bulkheads.,

A-Class bulkheads were originally required only aboard passenger vessels for "fire-resisting" boundaries called main vertical zones, spaced at intervals of 131 feet. Currently, A-Class boundaries are also required aboard cargo and tank vessels as well to contain fires in high potential hazard areas such as machinery spaces, galleys, and cargo holds. A-Class bulkheads are also required to protect areas such as control stations and stairways.

A-Class bulkheads are not required to perform any structural purpose relating to the strength of the vessel; however, a carefully planned vessel design could combine both structural strength and fire-endurance requirements.

A-Class bulkheads, in some locations, are required to have insulating capabilities. There are four types of A-Class bulkheads, each type being alpha-numerically designated to indicate its insulating capability. i.e.. A-60, L-30, A-15, and A-0 Class. An A-0 Class bulkhead is a minimum 11 USSG steel plate. A-30 and A-15 Class bulkheads are similar to A-60 Class bulkheads but are insulated with reduced thicknesses of approved structural (1 6&L Q07) insulation. The reduction in thickness of insulation has been determined by either full scale or laboratory furnace tests. In general, if 5 inches of insulation is required for 60 minutes of thermal protection, 30 minutes of protection can be achieved with (.75)8 inches of insulation and 15 minutes of insulation can be achieved with (.5) 5 inches. Figures 3e 1 e 1 through 3e 1.5 show acceptable arrangements for steel A-60, A-30, and A-15 assemblies. Any other arrangement of components is unacceptable unless fire tested to verify the performance of the assembly. These alternative arrangements must be approved by the Commandant.

Table 3.0

Structural Fire Protection Requirements
Within Accommodations and Service Areas.

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessel
Lamp, paint, and oil locker construction	Steel - A-Class 46 CFR 72.03-15(a)	Steel - A-Class 46 CFR 32.57-10(b)	Steel - A-Class 46 CFR 92.07-10(b)
Hull, Superstructure, structural bulkheads, decks, and deckhouse construction	Steel - A-Class 46 CFR 72.05-10(a)	Steel - A-Class 46 CFR 32.57-10(a)	Steel - A-Class 46 CFR 92.07-10(a)
Emergency generator room construction	Type 1 Space, Tables 46 CFR 72.05-10(d)-(g)	Steel - A-Class 46 CFR 32.57-10(b)	Steel - A-Class 46 CFR 92.07-10(b)
Construction of boundaries separating accommodations and control stations from cargo spaces, machinery spaces, galleys, main pantries and storerooms	See Tables 46 CFR 72.05-10(d)-(g)	Steel - A-Class 46 CFR 32.57-10(c)	Steel - A-Class 46 CFR 92.07-10(c)
Corridor bulkhead construction	Type 3 Space, intact from deck to deck Tables 46 CFR 72.05-10(d) & 72.05-10(e)	A or B-Class intact from deck to deck 46 CFR 32.57-10(d) (1)	A or B-Class intact from deck to deck 46 CFR 92.07-10(d) (1)

Table
Structural Fire Protection Requirements
Within Accommodations and Service Areas.

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessel
Stairtower, dumbwaiter elevator, and other trunk construction	Type 2 Space, Table 46 CFR 72.05-10(d) - (9)	Steel - A-Class 46 CFR 32.57-10(d) (2)	Steel - A-Class 46 CFR 92.07-10(d) (2)
Stateroom boundary construction (Not corridor side)	Type 5 or 6 space, Tables 46 CFR 72.05-10(d) - (9)	A, B, or C-Class 46 CFR 32.57-10(d) (3)	A, B, or C-Class 46 CFR 92.07-10(d) (3)
Stairway construction	Enclosure at one level only in accordance with 46 CFR 72.05-20(c) (2)	A or B-Class bulkheads and doors at one level only 46 CFR 32.57-10(d) (4)	A or B-Class bulkheads and doors at one level only 46 CFR 92.07-10(d) (4)
Stairtower construction	Enclosure trunk and doors at all levels in accordance with 46 CFR 72.05-20(c) (1)	A-Class trunk and doors at all levels 46 CFR 32.57-10(d) (4)	A-Class trunk and doors at all levels 46 CFR 92.07-10(d) (4)
Interior stairs construction (stringers & treads)	Steel 46 CFR 72.05-20(f)	Steel 46 CFR 32.57-10(d) (5)	Steel 46 CFR 92.07-10(d) (5)
Requirements for Deck Coverings (except toilet & washroom spaces)	3/8" or less of any material. Thicker materials must have 164.006 approval. 46 CFR 72.05-10(n)	3/8" or less of any materials. Thicker materials must have 164.006 approval. 46 CFR 32.57-10(d) (6)	3/8" or less of any materials. Thicker materials must have 164.006 approval. 46 CFR 92.07-10(d) (6)

Table 3.0
Structural Fire Protection Requirements
Within Accommodations and Service Areas.

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessels
Requirements for ceilings, linings, insulations, pipe and duct laggings	Approved 164.009 material 46 CFR 72.05-15 46 CFR 72.05-40	Approved 164.009 material 46 CFR 32.57-10(d) (7)	Approved 164.009 material 46 CFR 92.07-10(d) (7)
Requirements for sheathing, furring or holding pieces incidental to securing of bulkheads linings, ceilings & insulations	Approved 164.009 material 46 CFR 72.05-10(k)	Approved 164.009 material 46 CFR 32.57-10(d) (8)	Approved 164.009 material 46 CFR 92.07-10(d) (8)
Interior finish requirements (not corridors, stairways, stairtowers, or hidden spaces)	See 46 CFR 72.05-15	Up to 2mm. thickness of any material, or an approved 164.012 material or paint. NOTE - Control spaces are required to have an approved 164.012 material. 46 CFR 32.56-50	Up to 2/28" thickness of any material, or an approved 164.012 material or paint 46 CFR 92.07-10(d) (9)
Interior finish requirements for corridors, stairways, stairtowers, and concealed spaces.	See 46 CFR 72.05-15	An approved 164.012 material or paint 46 CFR 32.56-50(b)	An approved 164.012 material or paint 46 CFR 92.07-10(d) (9)
Requirements for Draft stops behind ceilings and linings if bulkheads are terminated at ceiling	Every 45 feet or less. 46 CFR 72.05-10(a)	Every 14 meters or less. 46 CFR 32.56-45	No Requirement.

Table
Structural Fire Protection Requirements
Within Accommodations and Service Areas

Requirement	Passenger Vessel	Tank Vessel	Cargo & Miscellaneous Vessel
Requirements for rugs and carpets in corridors, stairways and stairways	Wool or equivalent 46 CFR 72.05-10(c) Type 5 spaces must also meet this requirement. 46 CFR 72.05-55 (a) (4)	No Requirement	No Requirement

Steel pins and clips or other mechanical means are used to attach approved structural insulations to steel bulkheads. The pins are welded to the bulkhead and the insulation is then impaled on the pin and locked on with a speed clip. Accepted dimensions for these assemblies are: 1/8 inch diameter pins spaced on 12 inch centers with 1-1/4 inch diameter speed clips, figure 3.1.6, or the exact means used during the LIG CFR 16'1.007 approval test. Structural insulations are generally mounted by mechanical means. The use of adhesives is discouraged due to problems associated with aging and combustibility of the adhesive. After several years of installation, the performance of an adhesive under fire conditions cannot be guaranteed. Some types of approved insulations are mounted by being sprayed directly onto the bulkhead. It should be noted that the approval tests for these type materials involved only steel bulkheads. For application to aluminum bulkheads, additional investigation may be required. When structural insulations are installed, they should not terminate at the edge of the bulkhead or deck insulated, but should wrap around the joint and continue for at least 12 inches to prevent heat transfer through the edges, figure 3.1.7. One additional interpretation concerns deep web beams or frames. When insulating the under-side of a deck, the steel structural elements also require insulation. To prevent the use of excessive amounts of insulation, it is only considered necessary to insulate steel deep webs 12 inches below decks or away from bulkheads or the shell, figure 3.1.8.

B-Class Bulkheads

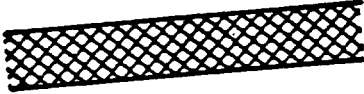
Generally, 3-Class bulkheads are 4 by 8 foot panels of 3/4 inch thick, non-combustible, binder board formed of asbestos¹ gypsum, or other materials, along with various inorganic binders, and are many times laminated with melamine or steel veneers. The panels are joined together by a system of steel connectors to form bulkheads and ceilings, hence the name joinerwork, figures 3.1.9 and 3.1.10. Joinerwork is the method used to subdivide a vessel's steel structure into compartments for accommodations and various service spaces. Joiner bulkheads do not extend from deck to deck. Where they form corridors or passageways, a continuous 16 USSG steel certain is provided between the top cap of the joiner bulkhead and the overhead steel deck. The use of B-Class panels will cause void spaces above ceilings and between bulkheads and the shell. Aboard passenger vessels and tank vessels, these void spaces must be fitted with both longitudinal and transverse draft stops every 45 feet to limit the maximum area within the void space. The draft stops should be non-combustible materials which meet a minimum B-0 requirement or alternatively, 22 gauge steel. The steel joinerwork or connector system used for bulkhead panels is very important. It is tested along with the bulkhead panel for its fire-endurance capability and its ability to prevent the transfer of heat, as well as its ability to remain in place during fire exposure. Each bulkhead panel that is Coast Guard-approved has specific joinerwork details noted as part of its approval. These plans are normally prepared to the following guidelines:

- (1) A sufficient number of vertical sections extending from deck to overhead should be shown to cover all pertinent installations on board the vessel. Separate details should be shown for all variations that are installed. Details should clearly depict the following:
 - (a) Base and overhead fixation of the basic panel.
 - (b) ceiling or lining attachments to the basic panel (if applicable).
 - (c) Draft stop attachment to the basic panel and overhead (if applicable).

¹ See NVC 5-80, "Recommended Procedures for Control of Asbestos Hazard on Board Merchant Vessels, OCS Facilities and Deepwater Ports."



Approved Structural Insulation
46 CFR 164.007



Approved Bulkhead Panel
46 CFR 164.008



11 USSG Steel

S=Thickness of Approved Structural Insulation to meet Class A-60 requirements without other insulating materials.

P=Thickness of Approved Bulkhead Panel to meet Class B-15 requirements. The use of fractional values of P will be accepted for homogeneous materials only.

CLASS A-60 BULKHEADS

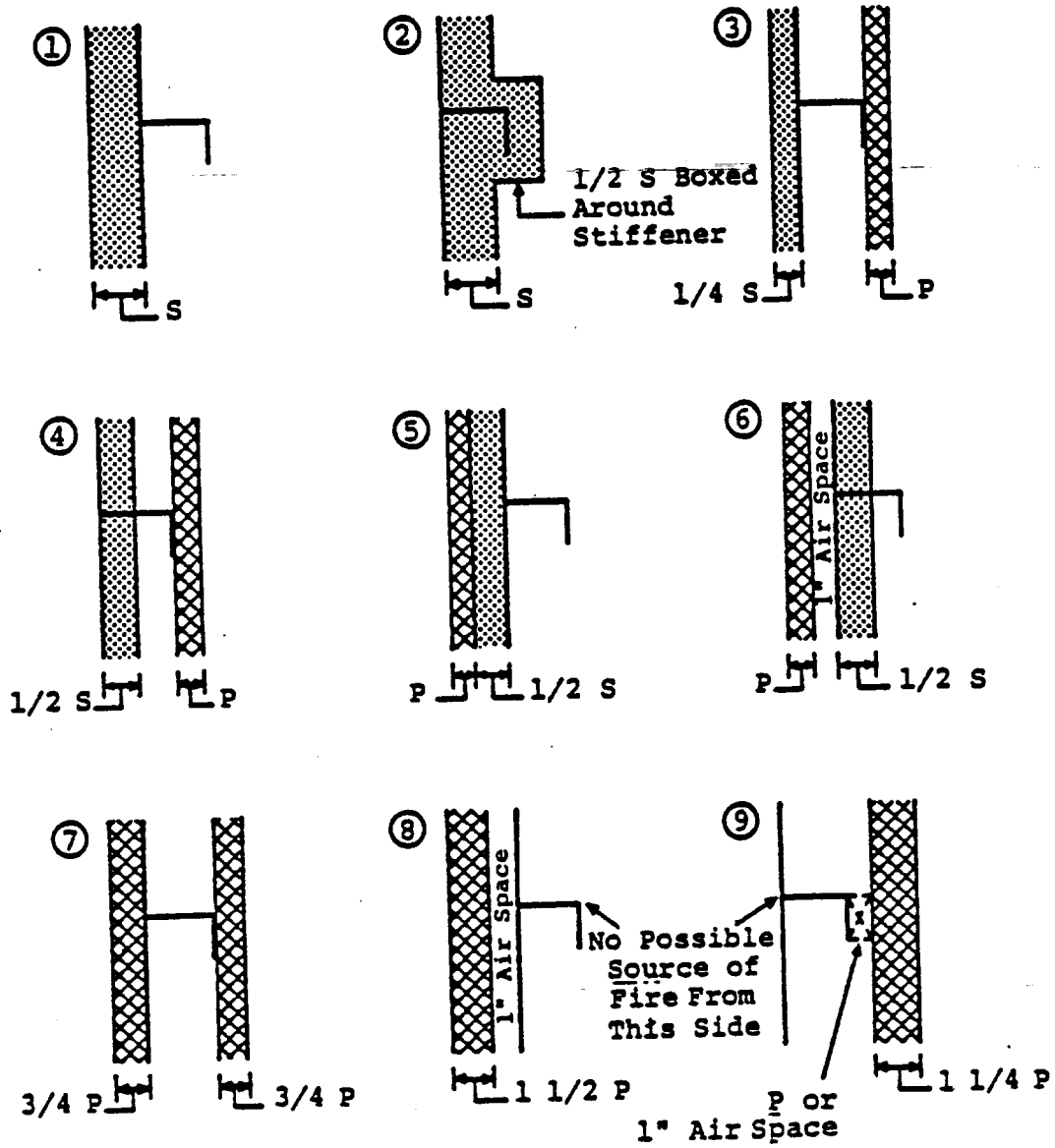


Figure 3.1.2

CLASS A-30 BULKHEADS

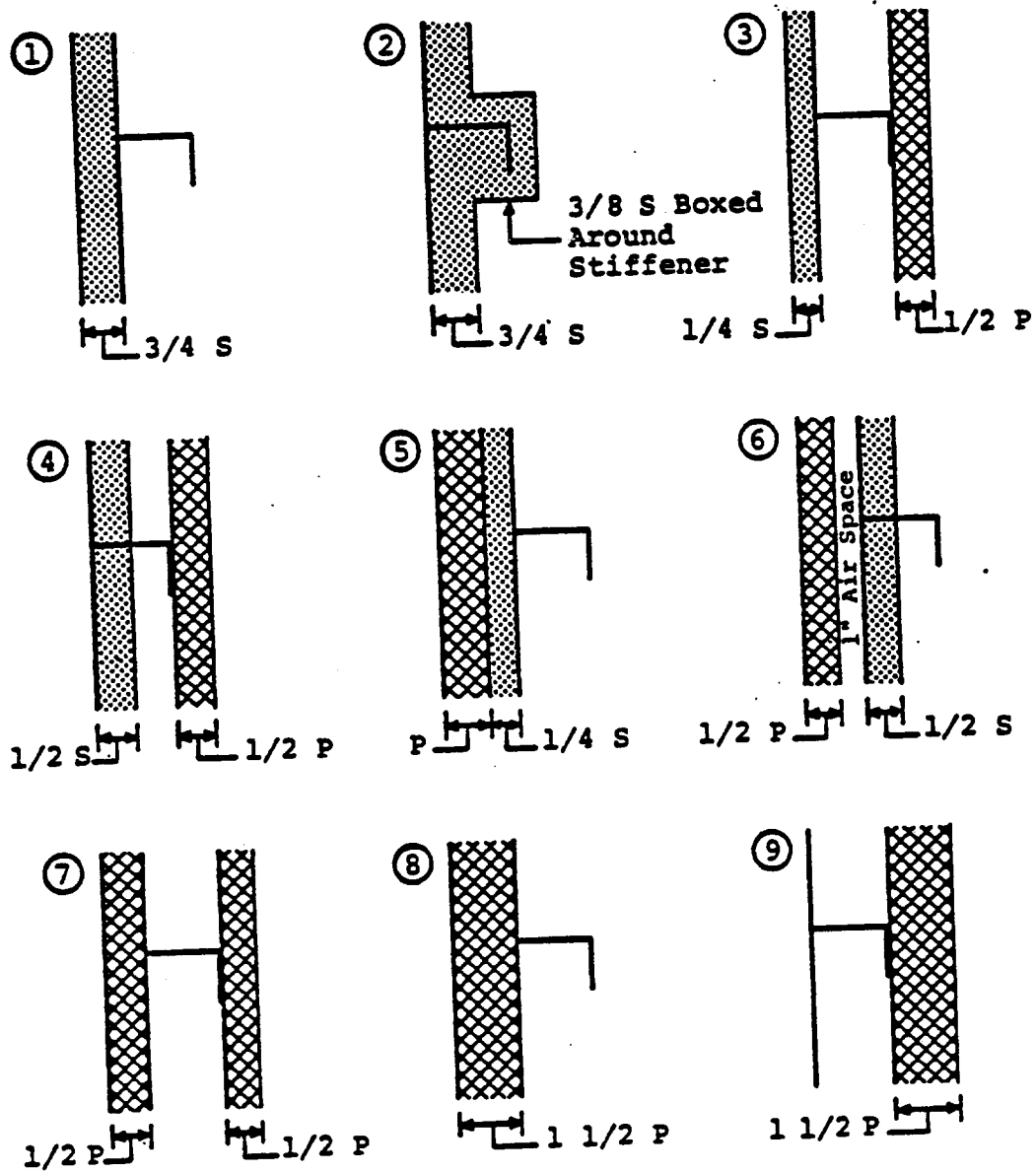


Figure 3.1.3

CLASS A-30 BULKHEADS

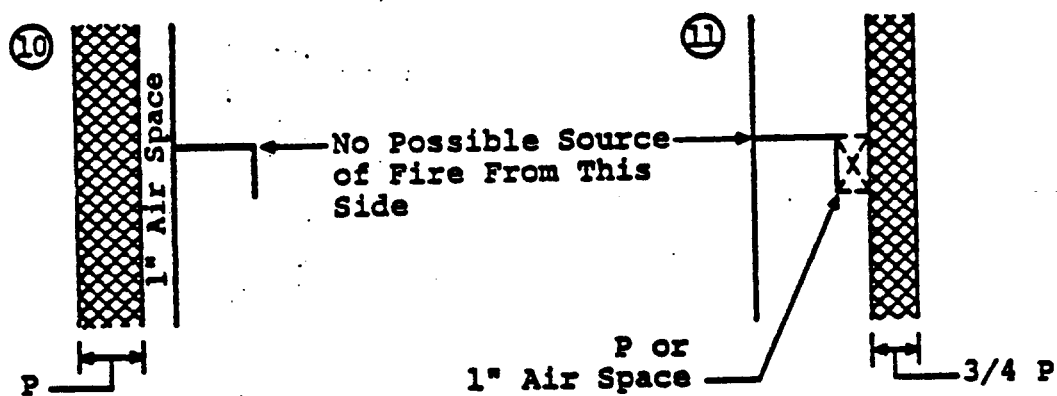


Figure 3.1.4

CLASS A-15 BULKHEADS

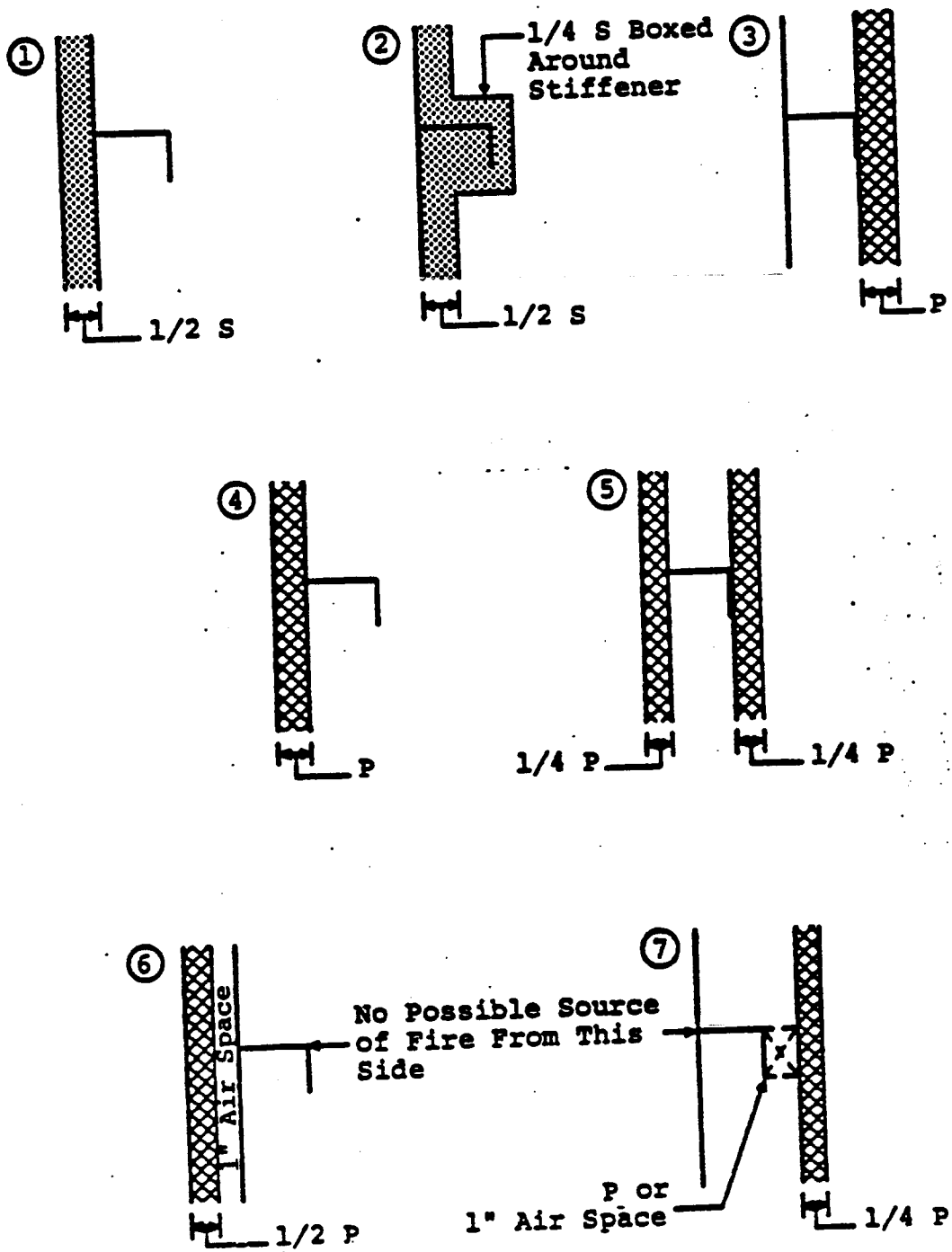


Figure 3.1.5



Figure 3.1.6-Partially Completed Installation of 46 CFR 164.007
Approved Insulation. Note Steel Pins and Speed Clips.

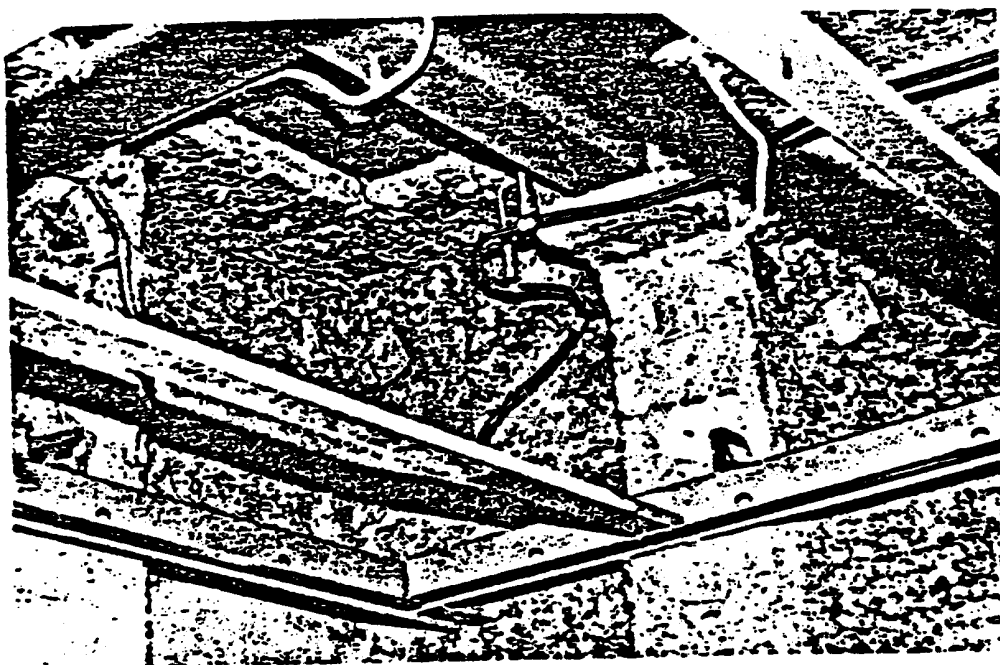


Figure 3.1.7-Typical Installation of Bulkhead Insulation Showing 12 inch Overlap at Corners.

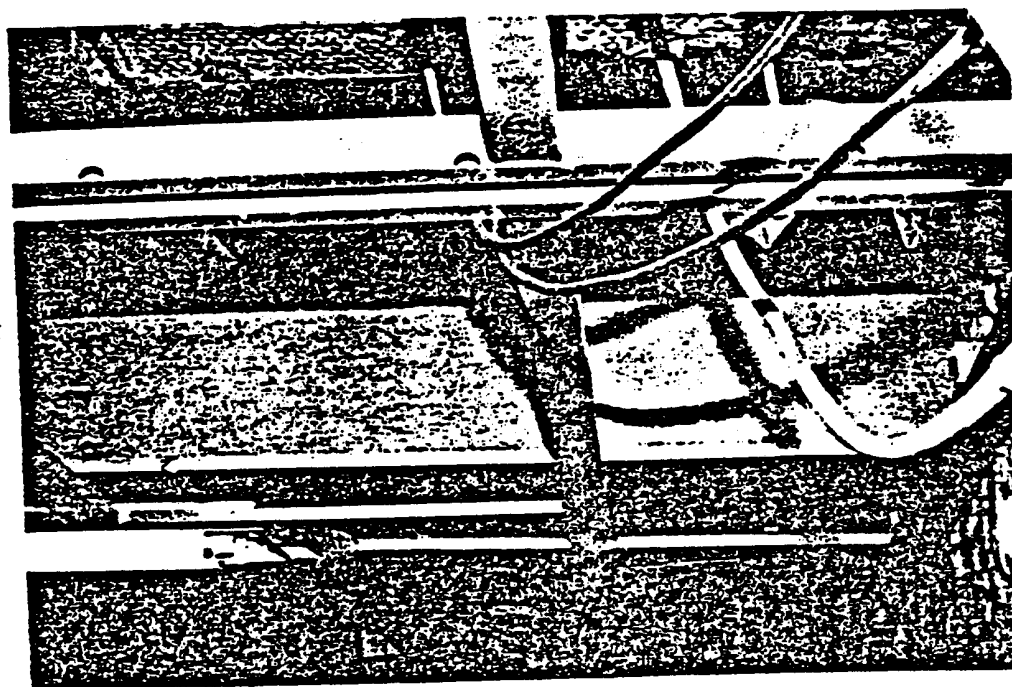


Figure 3.1.8-Insulation of Deep Web Beam. Note That Insulation Terminates 12 Inches Below Overhead.

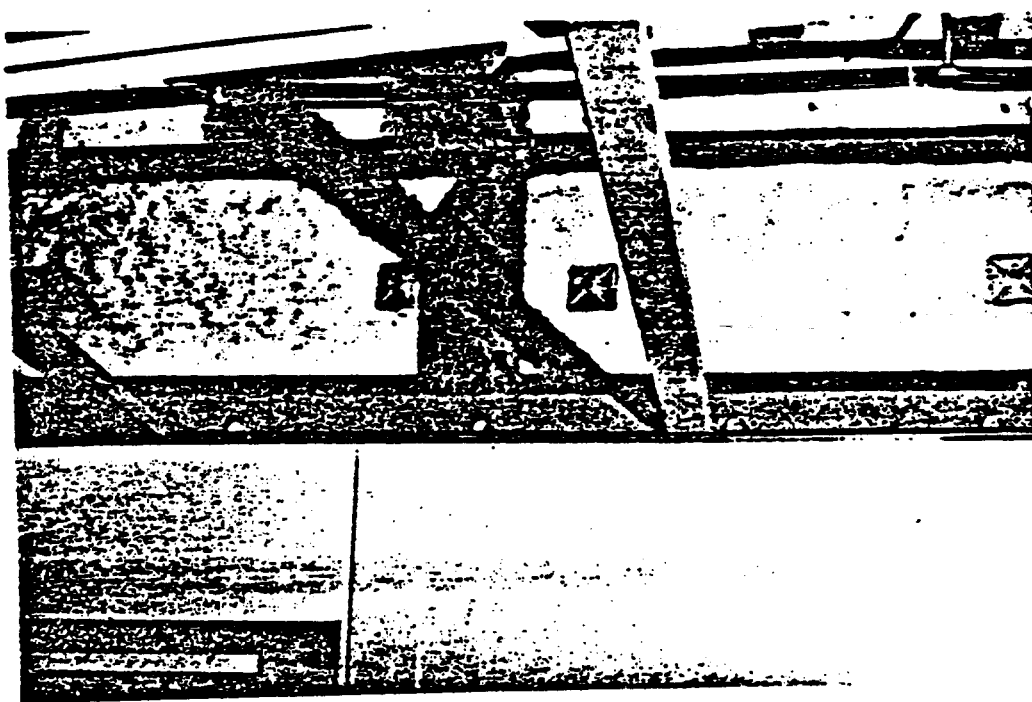


Figure 3.1.9-Joiner Work System Showing Ceiling/Bulkhead Interface.

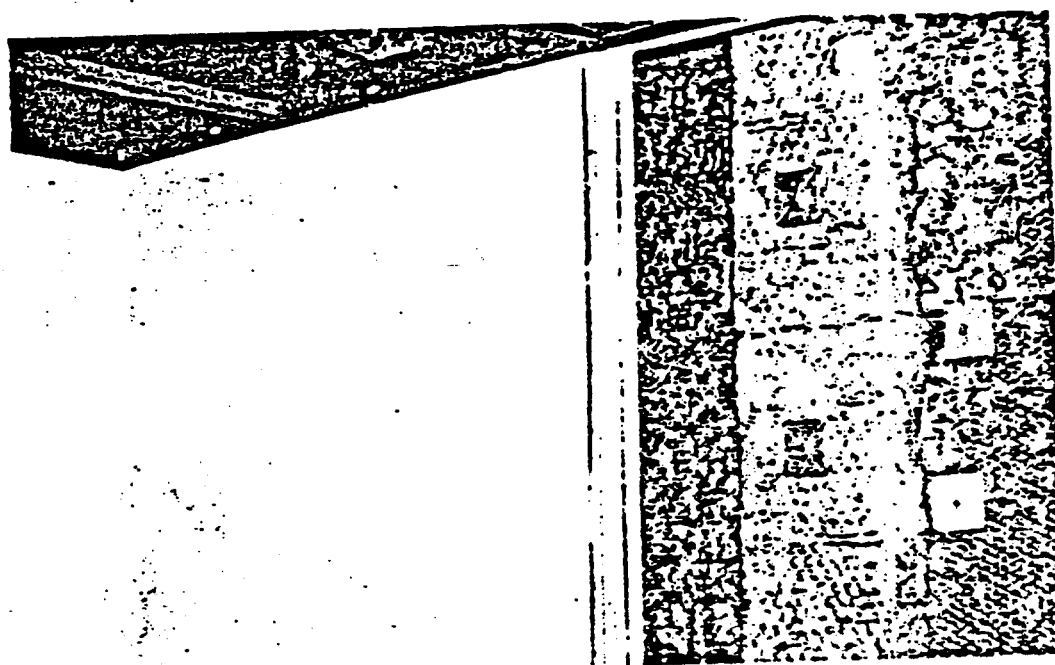


Figure 3.1.10-Joiner Work System Showing One Bulkhead Panel in Place With H-Post Connector, Awaiting Installation of Next Panel.

- (d) Basic dimensions and gauges of all metallic erection pieces, such as retaining shapes, furring pieces, flat bars, and trim used for retaining purposes.
 - (e) The type, size, and spacing of all bolts and screws pertaining to the fixation of the basic panel or draft stop.
- (2) A sufficient number of horizontal sections should be shown to cover all pertinent installations on board the vessel. Details should clearly depict the following:
- (a) Two bulkheads joining in a TEE where no joint occurs.
 - (b) Two bulkheads joining in a TEE where a joint occurs.
 - (c) Four bulkheads joining in a CROSS with one thru bulkhead.
 - (d) Four bulkheads joining in a CROSS with no thru bulkhead.
 - (e) Two bulkheads butted (H post construction).
 - (f) Two bulkheads butted (other construction).
 - (g) Outside corner detail.
 - (h) All variation of door jam connections to bulkheads.
 - (i) Bulkhead to lining detail (if applicable)
 - (j) The type, size, and spacing of all bolts and screws pertinent to the fixation of the basic panel, effective lining, or draft stop.
- (3) The heads of screws or bolts used in securing the composition panel should not rest directly against the panel itself. Metal backing plates and/or metal trim should be used.
- (4) Self tapping screws or bolts, of sufficient length to completely penetrate the composition panel and the metal plate on the far side such that at least two threads of parallel-threaded section in addition to the taper length extend beyond the combined thickness of materials being joined, should be used for all screws or bolts required for panel fixation.
- (5) Self tapping screws similar to Parker Kalon Screws should be at least 3~16 inch longer than the overall thickness of all material through which is passes.
- (6) Self tapping Parker Kalon screws used for the fixation of effective panels, linings, ceiling, and/or draft stops should meet the following minimum requirements:
- (a) Required length up to 3/8 inch - #6 on 8 inch centers.
 - (b) Required length 5/8 to 1 inch - #8 on 10 inch centers.

- (c) Required length over 1 inch -#10 on 12 inch centers.
- (7) No requirements are placed on the size or spacing of screws used to affix trim to any panel when the trim is IN NO WAY used to afford fixation for the panel.
- (8) Vertical joint pouts, corner posts, and horizontal retaining shapes should be at least 16 USSG steel, except that such shapes may be folded from 20 USSG steel sheets of double thicknesses, with at least a 3/4- inch lap into the panel.
- (9) All vertical butt members should be effectively fixed top and bottom in such a manner as to insure that these metallic butt members afford positive support to the panels.
- (10) All horizontal members providing top and bottom panel fixation should be effectively attached to the hull or its framing.
- (11) Threaded fastenings which are anchored in approved noncombustible panels may be used for decorative attachment only. Threaded fastenings providing structural support should be such that the holding power is derived from metallic seatings of the fastenings.

C-Class Bulkheads

It is sometimes desirable to install bulkheads to serve only as partitions. These bulkheads need perform no structural fire protection purpose; however, they must not contribute to the fuel load of the compartment in which they are installed. Bulkheads fitting this category are designated as C-Class bulkheads. C-Class bulkheads are required to be noncombustible in accordance with 46 CFR 164.009. Aboard cargo and tank vessels, C-Class bulkheads may be used for stateroom boundaries which do not form corridors. In this installation, they are not required to extend from deck to deck.

3.2 Decks

Decks function within the structural fire protection system to limit the vertical spread of fire and smoke. Due to classification society requirements for deck plating, it is unlikely that one will ever encounter a steel deck that does not meet the minimum thickness requirements for an A-Class division. Although all decks within accommodation and service areas aboard cargo and tank vessels are not specifically required to be A-Class by the regulations, it would be imprudent to not treat these divisions as such. It is generally felt that all deck penetrations should be constructed to provide A-Class integrity.

The insulation of decks for fire protection purposes can be accomplished by two methods. One is to insulate the deck plating from beneath with structural insulations, figure 3.2.1., or bulkhead panels, and the other is to apply approved deck coverings on the topside of the deck. Because more of the materials used for the latter purpose can also act as finishing or leveling surfaces, it may be more economical to use this method for the insulation of a steel deck. Materials approved as noncombustible materials under 164.009 may also be used as deck covering without limitation. Deck coverings are generally composed of several layers of different materials. Most steel decks are not smooth or level enough to apply a surface covering directly to the steel, so a deck covering

or underlay is employed for leveling and smoothing purposes. Within service and accommodation areas, or where specifically required, deck coverings must be of an approved type; however, an overlay of up to an average of 3/8 of an inch of any material is permitted to be installed on top of the approved deck covering. This allows several options: (1) A deck may be covered with 3/8 of an inch of any material, or (2) an approved thickness of an approved deck covering may be installed beneath the 3/8 inch thick overlay. (If a Latex mastic or other material is used to bond the deck covering to the steel, it must be part of the 46 CFR 164.006 approval.), or (3) a deck covering of approved thickness can also be used alone. If a rug or carpet is to be installed, it is not considered an overlay. Deck coverings are approved by test as specified in 46 CFR 164.006. Many of the approved deck coverings are some form of magnesium oxychloride cement (magnesite). Figures 3.2.2 through 3.2.5 show acceptable arrangements for steel deck assemblies.

Rugs and Carpets

Rugs required to be wool or equivalent are any wool rug or any other rug which, when tested to ASTM standard E-84, has a flame spread rating of 75 or less and a smoke developed rating of 100 or less. If an underpad is used, it also must meet the same flame spread and smoke developed criteria. The rug must be tested exactly as it is intended to be installed; however, underpaddings may be tested separately. When carpets are installed aboard ship, the use of wooden carpet strips is acceptable. If these strips are used aboard passenger vessels, they should be included in the calculations required by 46 CFR 72.05-15(c). For all installations, rugs and carpets should not pass beneath doors. A sill or open space of a minimum width equal to the jamb depth of the door frame should be provided. This gap is to insure that flame spread does not occur through undercut doors.

Combustible cove mouldings may be used at the deck-bulkhead junction; they are considered an extension of the permissible 3/8 inch overlay.

3.3 Means of Escape

As previously mentioned, the basic purpose of structural fire protection is to provide a life safety system for the ship's crew and passengers. The configuration of corridors, doors, and stairways is highly important to this system. Two means of escape are necessary from all living and working areas. The means of escape are required to be bounded by structural fire protection to maintain tenable conditions for a minimum period of time, during which escape from untenable areas may be accomplished.

Several general principles apply to all escape routes. If the escape path involves access through watertight doors, it is possible that escape could be blocked to maintain the watertight integrity of the vessel. Therefore, at least one escape route from all areas should be independent of watertight doors. Additionally, the two means of escape should be located as far apart as possible. This concept is intended to prevent any one incident from blocking both escapes. Vertical ladders should not be used as a means of escape unless it can be demonstrated that no other arrangement is possible. In all cases, elevators must not be used as a means of escape. Dead-end corridors of more than 40 feet in length are not permitted. The 40-foot limit is normally measured from the exit of the most remote space to the point where escape in two directions is possible. Figure 3.3.1 illustrates this principle.

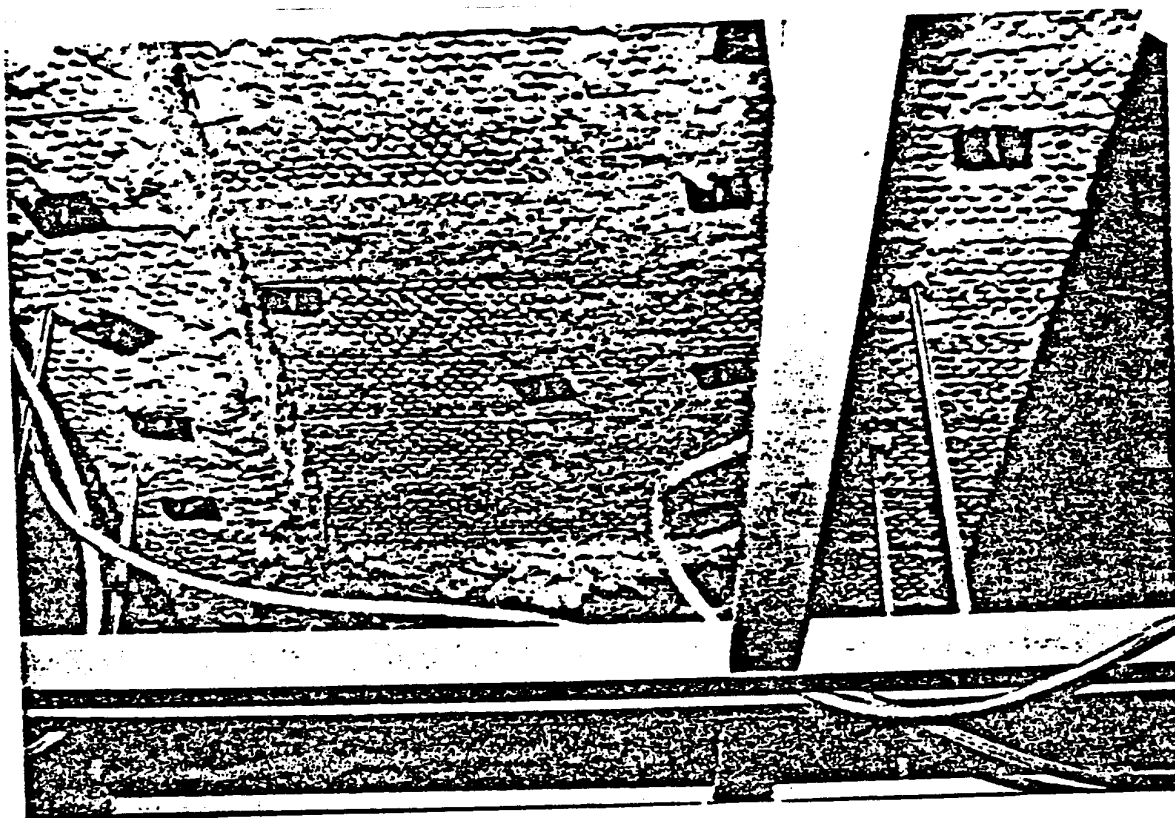


Figure 3.2.1-Typical A-60 Deck, Insulated From Beneath.

Legend:



Approved Deck Covering
46 CFR 164.006



Approved Structural Insulation
46 CFR 164.007



Approved Bulkhead Panel
46 CFR 164.008



Steel Deck

D=Thickness of Approved Deck Covering to meet Class A-60 requirements without other insulating materials.

S=Thickness of Approved Structural Insulation to meet Class A-60 requirements without other insulating materials.

P=Thickness of Approved Bulkhead Panel to meet Class B-15 requirements. The use of fractional values of P will be accepted for homogeneous materials only.

Figure 3.2.2

CLASS A-60 DECKS

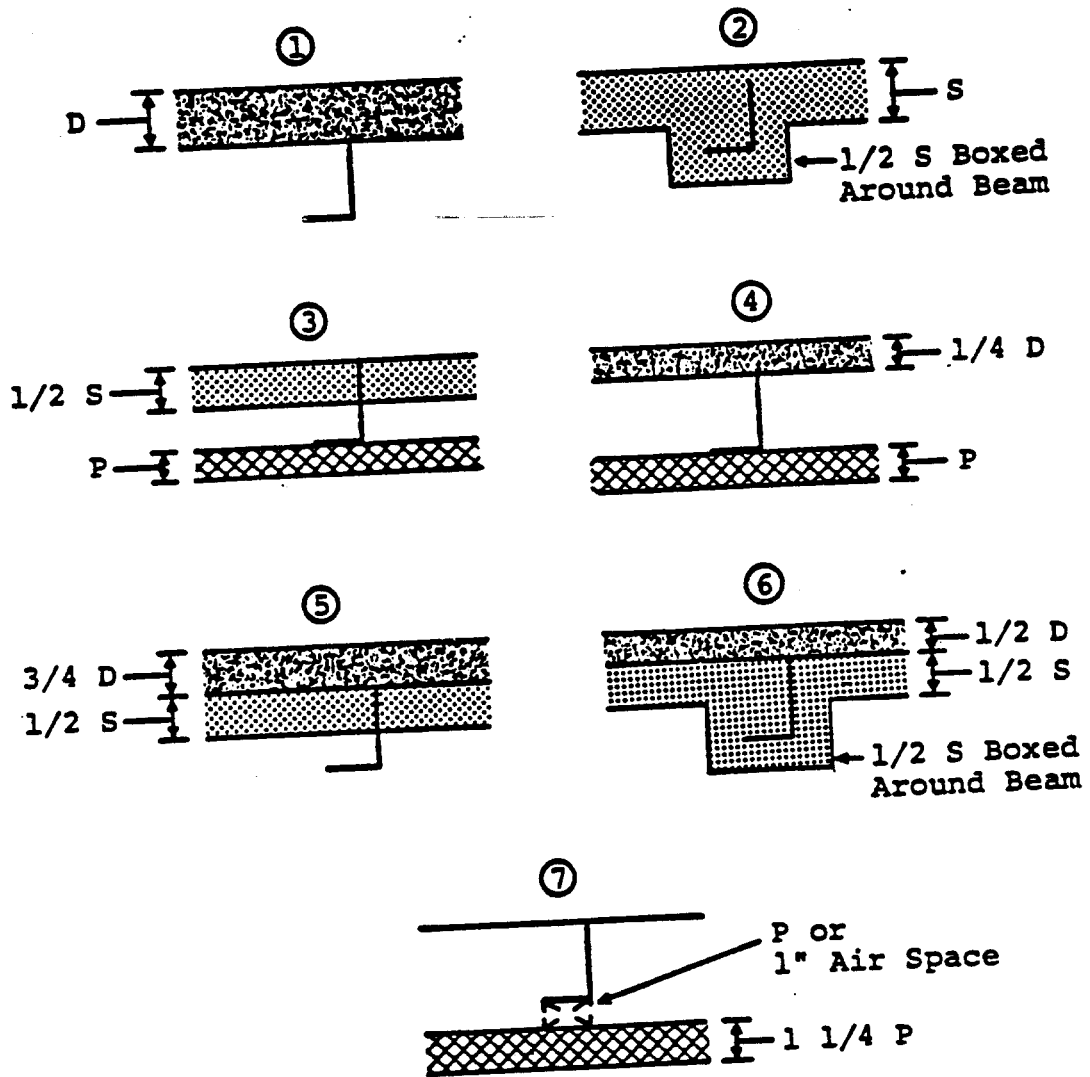


Figure 3.2.3

CLASS A-30 DECKS

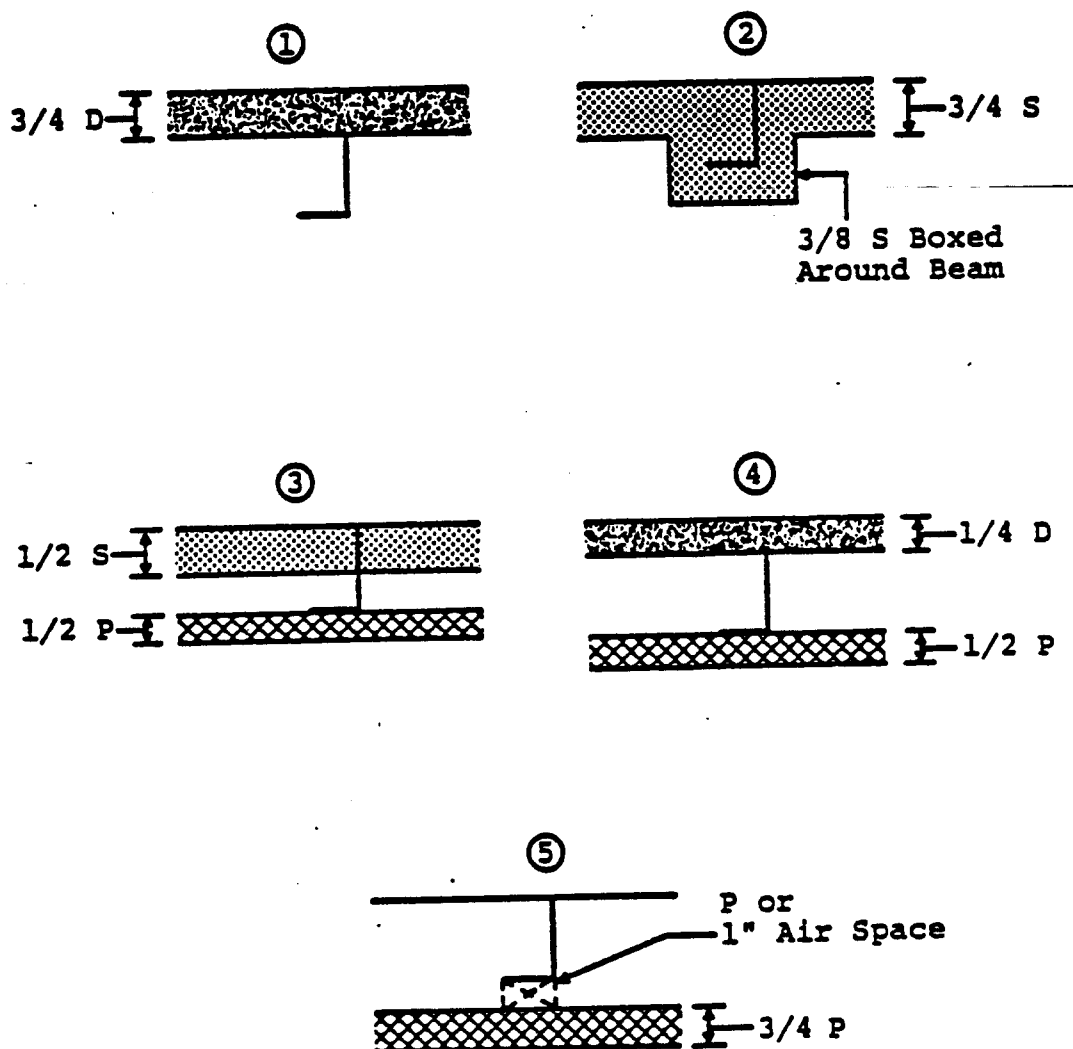
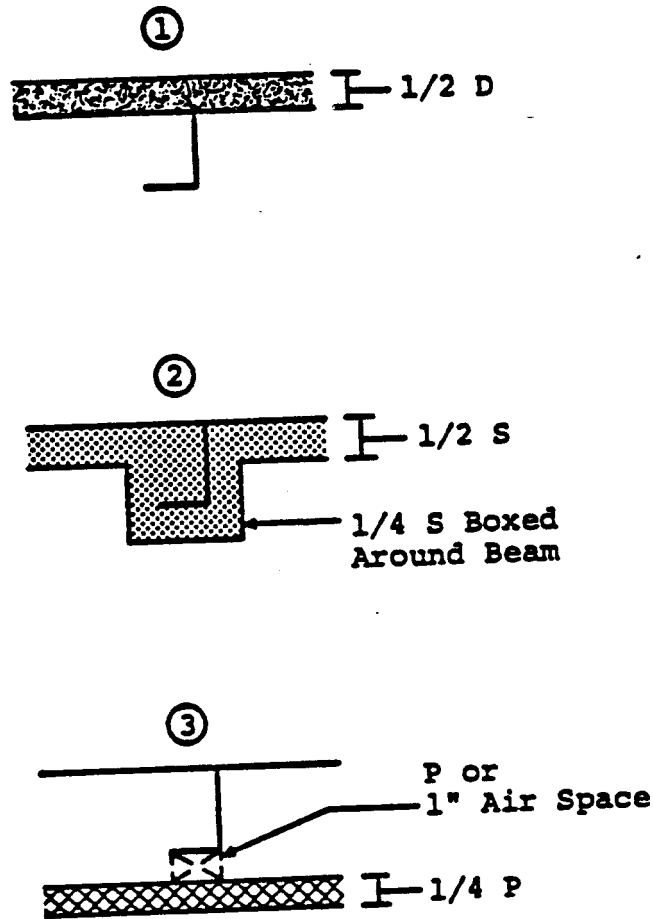


Figure 3.2.4

CLASS A-15 DECKS**Figure 3.2.4**

Particular attention must be paid to means of escape aboard passenger vessels and 46 CFR subchapter T vessels which must comply with 46 CFR Subpart 72. Because both types of vessels can carry large numbers of passengers, it is important that escape routes be arranged to provide a rapid and smooth flow of persons to the embarkation areas. This requires that all doors in an escape path open in the direction of travel to the lifeboats, and that all doors be unlocked or provided with panic hardware which can be easily operated in an emergency. The width of escape routes should be determined on a deck-by-deck basis according to the potential number of persons

on that deck. The width should not decrease in the direction of normal escape. As a guide in determining the occupant load per deck, the following passenger densities may be used:

- (1) Passenger staterooms - designed capacity.
- (2) Crew stateroom - 2/3 designed capacity.
- (3) Theaters, dining halls and other spaces with fixed seating arrangements - maximum seating capacity.
- (4) Lounges, bars, etc. - 1 person per 20 sq. ft.
- (5) working spaces - normal operating capacity.

Additional regulations are contained in 46 CFR 72.05-20.

Stairways and Stairtowers

Stairways and stairtowers form the primary means of escape from lower level deck areas. As such, it is vital that these enclosures be designed to provide a means of escape during periods of fire and also to prevent the spread of fire between decks. There are two basic designs specified by the regulations. The first involves a stairway which only penetrates a single deck. Because this enclosure is a penetration of only one deck, it is only necessary to provide a door and enclosure bulkheads at one level to prevent flame and smoke spread. The second design involves a stairway which penetrates more than one deck. Such a stairway is considered a stairtower. A stairtower is a continuous vertical steel trunk constructed to a minimum A-0 Class standard. Self closing A-Class doors are required at each entrance to an exit from a stairtower. If a lining such as joinerwork bulkheading is installed inside the A-Class trunk, draft stops should be provided at each deck level to prevent flame spread within the stairtower. Figure 3.3.2.

These are the only designs contemplated by the regulations. Other designs which place several stairways (each of which penetrates only a single deck) vertically above or adjacent to each other are not considered equivalent to a stairtower and are not permitted by the regulations. This is a practice which has been permitted by various district commanders (mitt) and will no longer be permitted.

Ventilation Systems

Ventilation systems used to supply or exhaust heated or air conditioned air within accommodation and service spaces must be carefully evaluated as components of the structural fire protection system. Because the ductwork for a ventilation system is common to many spaces, it could easily cause the spread of flame or smoke if improperly designed. The current tank and cargo vessel regulations do not specifically detail the fire protection requirements for ventilation systems, but rather they specify the intended performance requirements of the bulkheads and decks penetrated by the ducting.

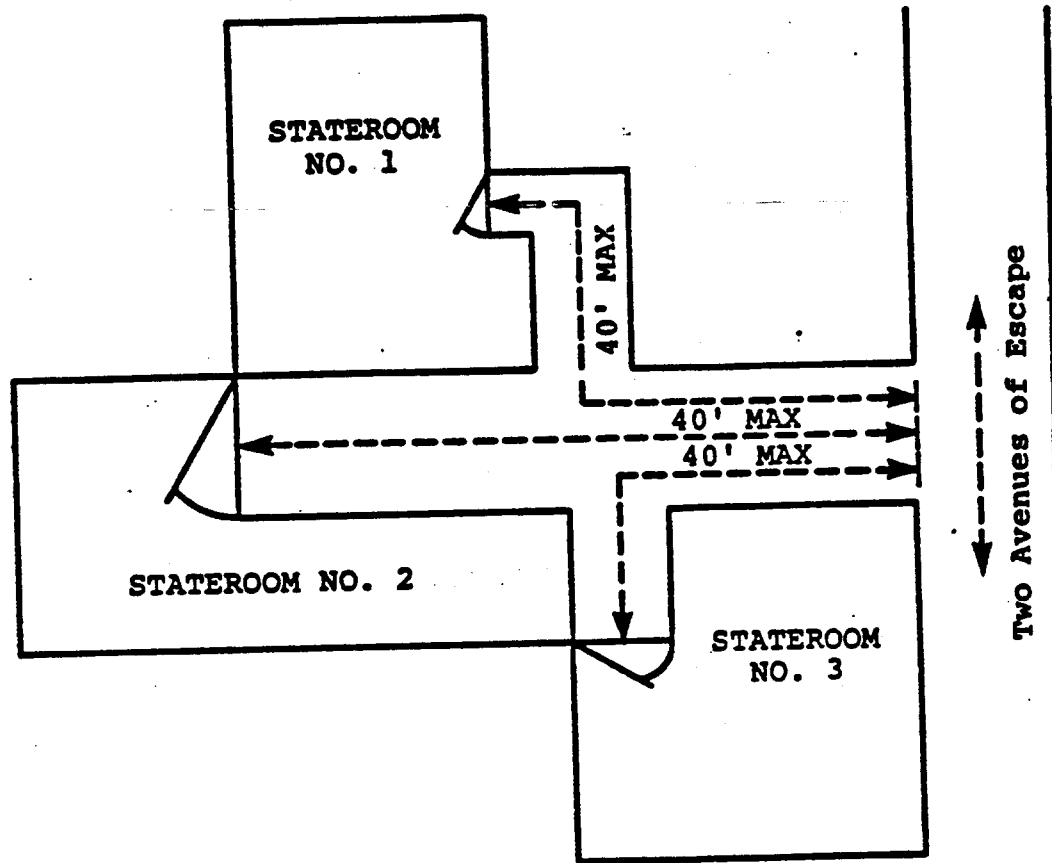


Figure 3.3.1. Dead End Corridor; Typical Permissible Limits

Boundary bulkheads of galleys, paint and lamp lockers, emergency generator rooms, and boundary bulkheads and decks separating accommodations and control stations from cargo and machinery spaces, galleys, main pantries, and storerooms are required to be of A-Class construction. penetrations of these boundaries must therefore provide an equivalent degree of protection. Another Coast Guard requirement specifies that combustible materials may not be used in hidden or concealed spaces within accommodation and service areas. Based upon the above two requirements, ventilation ducting must be constructed of non-combustible materials, and should not violate the integrity of A-Class bulkheads and decks. The Coast Guard requires a fire damper at each penetration of an A-Class division. If the ductwork is a minimum 11 USSG steel, and passes through the space without opening into that space, however, dampers need not be provided. If the duct passes through a boundary required to be B-Class, it also must meet the same requirements as that boundary, i.e., it must prevent the passage of flame for 30 minutes. It has been the policy of

the Coast Guard to accept ductwork of 22 USSG steel or heavier as meeting this requirement. If a duct constructed of 22 USSG steel or heavier is routed the length of a corridor with branches into individual staterooms, fire dampers are not required at each penetration of the B-Class corridor bulkheads. A fire damper is required at each duct opening within the corridor, if the corridor ventilation is common with the stateroom system. These general requirements are intended to allow several options when planning a vessel design. Currently several acceptable alternatives for duct arrangement exist. Figures 3.4.1 through 3.4.2 show the basic application of these principles.

Fire Damper Construction

Specific requirements for fire dampers and associated ductwork are not contained in the vessel regulations. The basic requirements for fire dampers are contained in the definition of A-Class or B-Class divisions. A duct must be equivalent to the bulkhead or deck penetrated. Therefore, the duct must be provided with a damper which meets the same requirements for flame and smoke passage. The actual physical constraints of damper construction reveal that complete closure of a damper is only possible at prohibitive cost. Therefore, dampers are designed to meet a construction rather than a performance standard. For A-Class division, fire damper blades and casings must be constructed of a minimum 11 USSG steel. A maximum gap of 1/8 inch between the blade and casing is permitted. The components (i.e., springs, hinges, etc.) of the damper must be constructed of stainless steel or other steel, suitably coated to prevent corrosion. Manually operable steel fire dampers listed and labeled by Underwriters Laboratories, Inc. as 1-1/2 hour fire dampers are acceptable, regardless of their construction. Fire dampers for B-Class divisions must be designed similarly to those for A-Class divisions; however, the thickness of steel may be reduced to a minimum 16 USSG.

Fire Damper operation

All fire dampers must be capable of manual operation. The controls for the operation of a fire damper are usually located outside the space served by the ventilation system, figure 3.4.3. Strict adherence to this requirement could produce an ineffective system. Spaces such as control stations, wheelhouses, or emergency generator rooms where it could reasonably be expected that crew members would take refuge or continuously be manned during fire exposure should be arranged to permit closure of fire dampers from inside the space. Fire dampers which are installed in main vertical zone bulkheads must also be capable of automatic operation. These dampers must be installed to close in the direction of normal air flow to prevent their being held in the open position. Normally, automatic dampers are designed to close by the melting of a fusible link at 165°F (Dampers installed in galleys or similar spaces are designed to operate at 212°F) specific requirements for passenger vessels are listed in 46 CFR 72.05-50.

3.5 Elevators

Elevators are finding an increased popularity aboard types of vessels. Because elevator trunks penetrate several decks, they provide the same possibilities for flame and smoke spread as stairways. From a structural fire protection viewpoint, specific precautions must be taken to protect elevator trunks against flame and smoke spread.

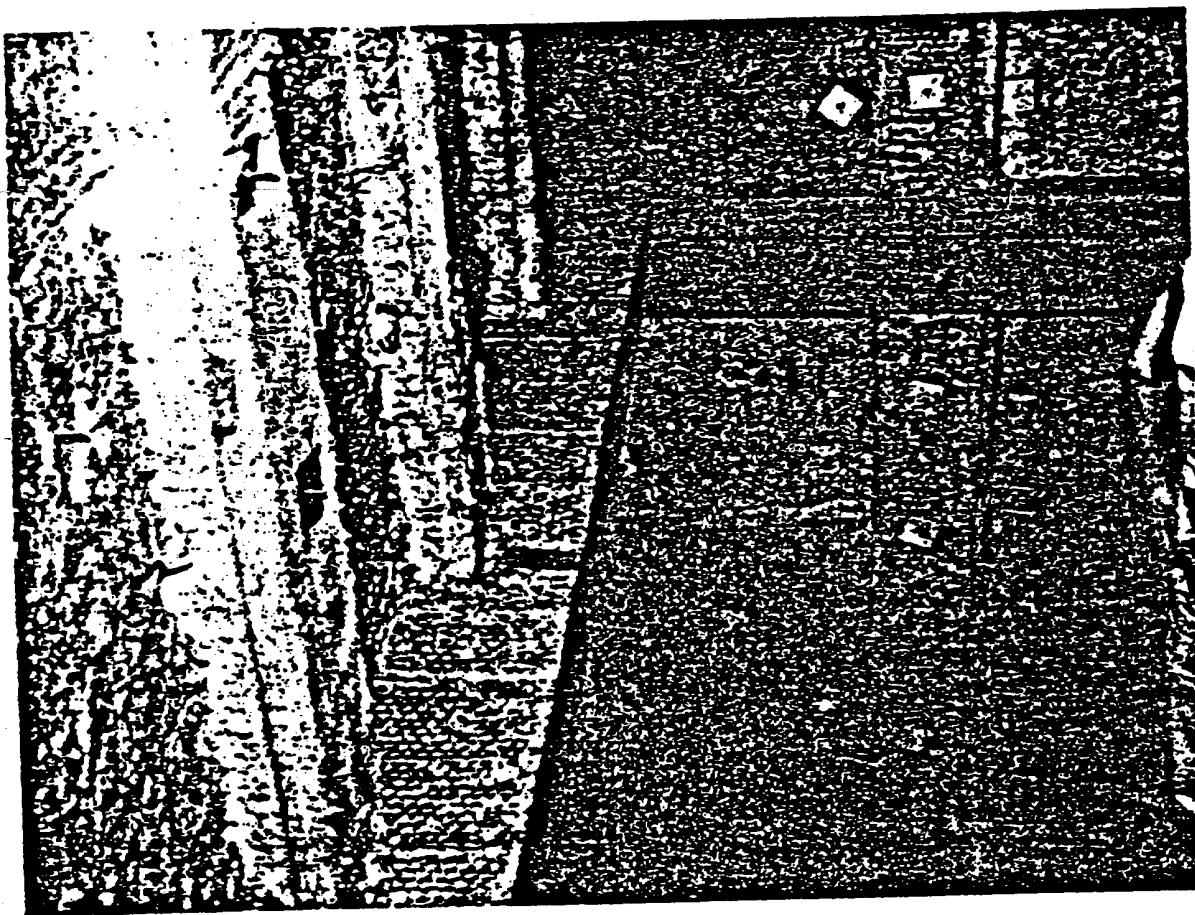
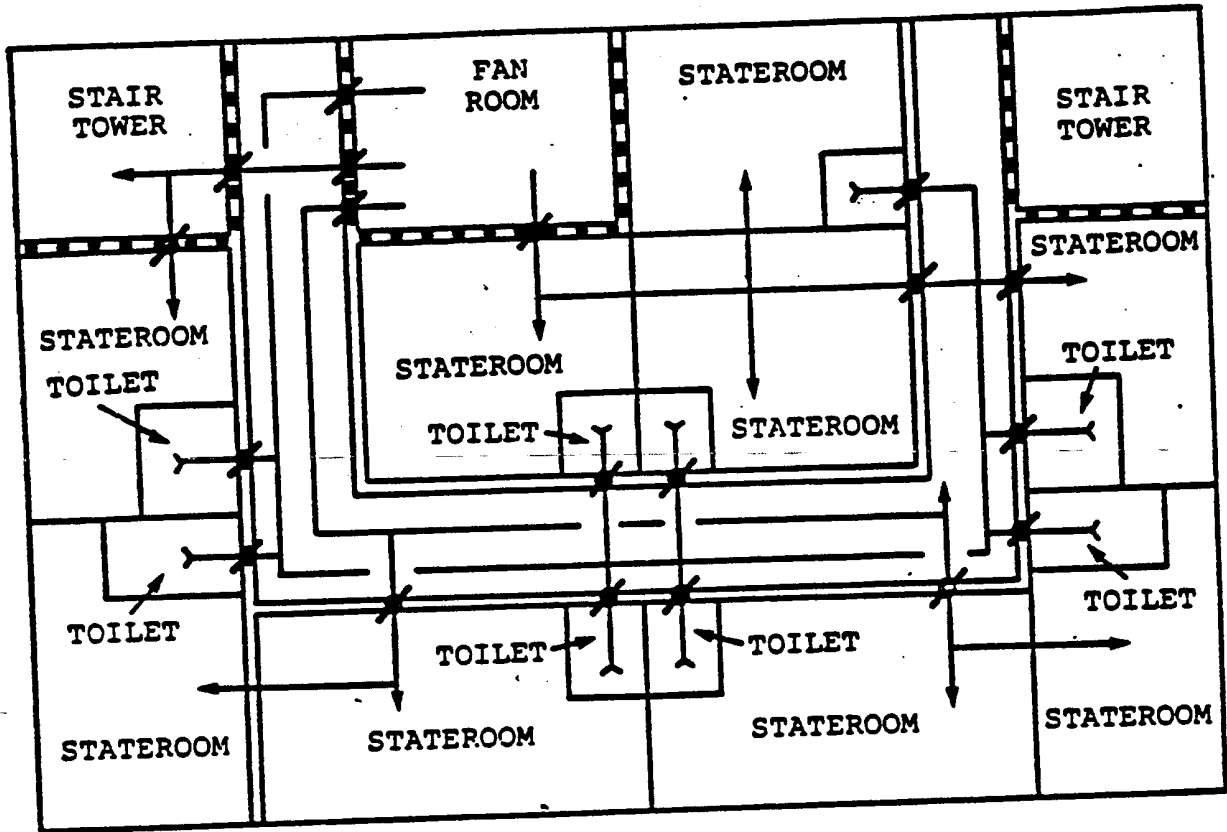
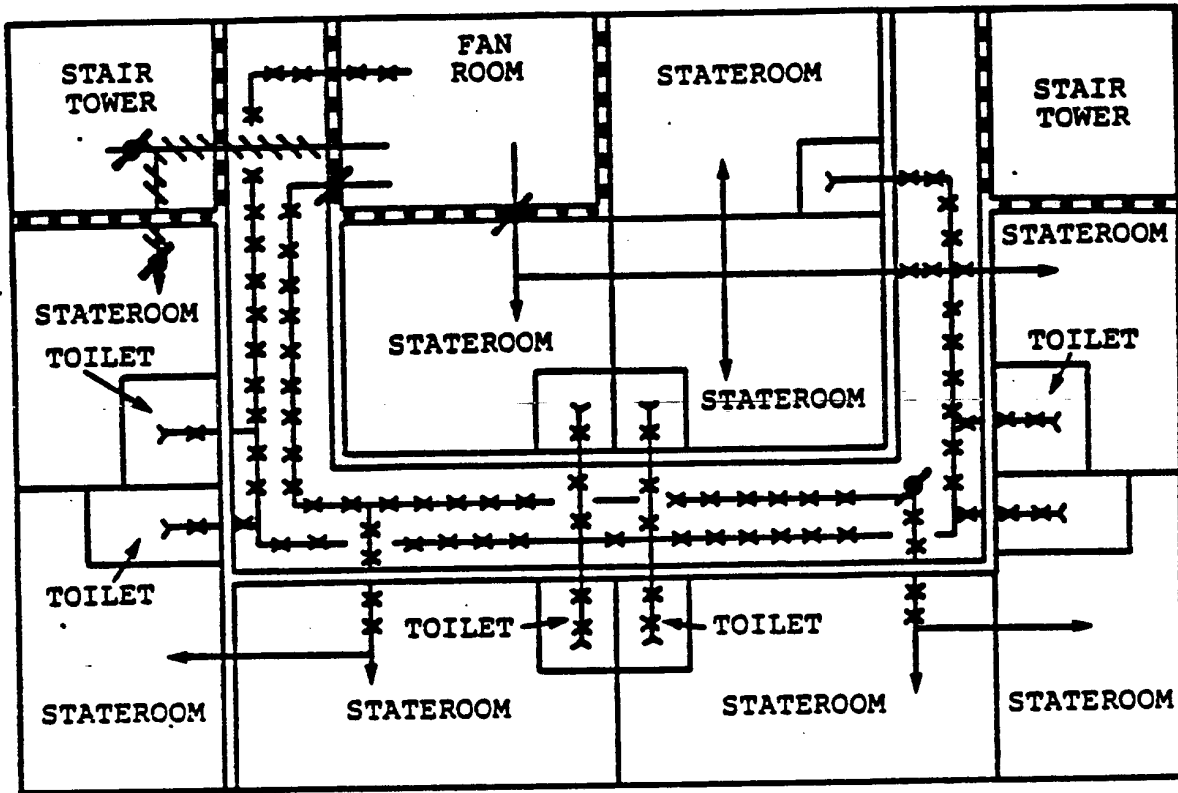


Figure 3.3.2-Draft Stop in Stair Tower Lining Between Decks.



- Fire Dampers
- ==== "B" Class Bulkhead
- - - - "A" Class Bulkhead
- _____ Ducting, any gauge or any noncombustible material
- x - x - x - Ducting of at least 22 gauge steel or equivalent material
- \\\\\\\\\\\\\\\\ Ducting of at least 11 gauge steel or equivalent material

Figure 3.4.1









-  Fire Damper
-  "B" Class Bulkhead
-  "A" Class Bulkhead
-  Ducting, any gauge or any noncombustible material
-  Ducting of at least 22 gauge steel or equivalent material
-  Ducting of at least 11 gauge steel or equivalent material

Figure 3.4.2

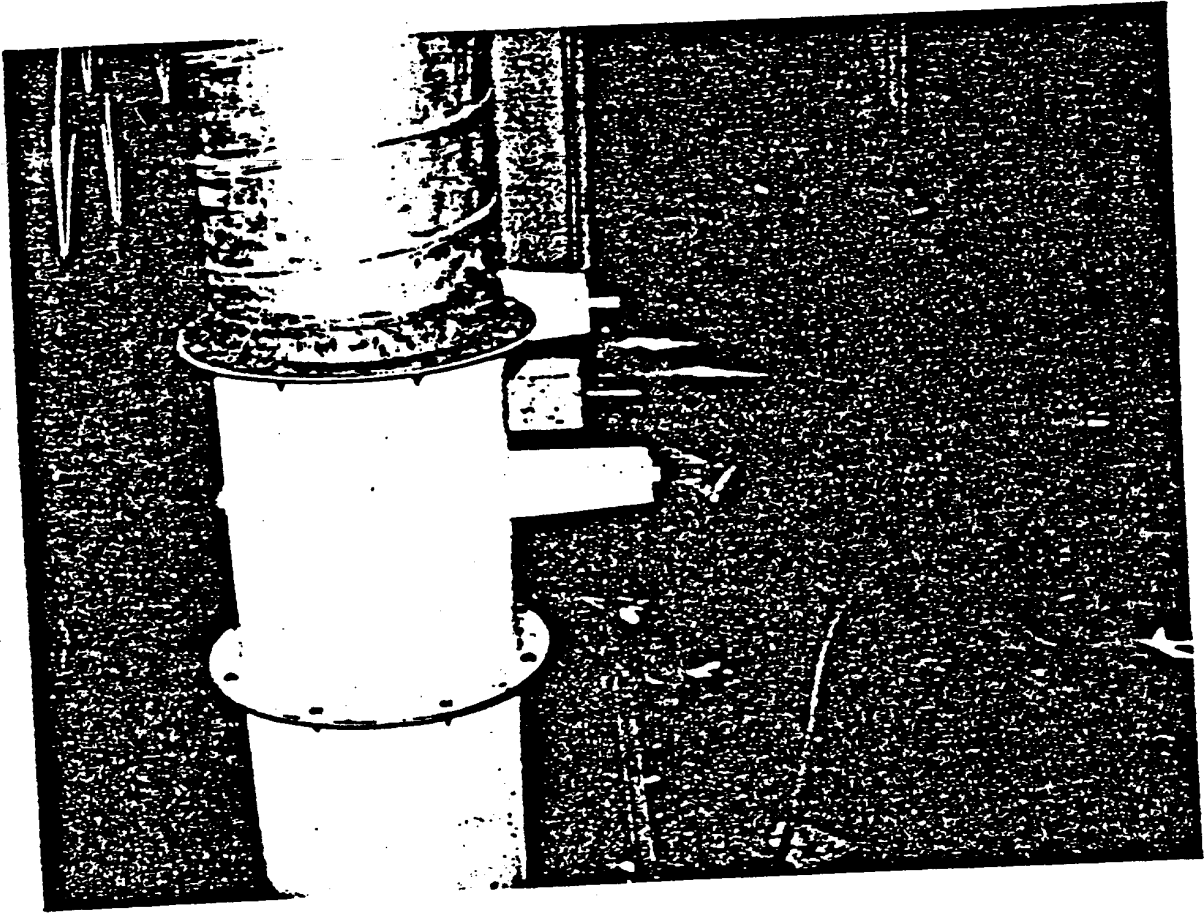


Figure 3.4.3-Typical Manual Damper Located in Space One Deck Above Service Area.

The elevator shaft, being a trunk, is required to be A-Class aboard all vessels. (Aboard passenger vessels, an elevator enclosure is considered a type 2 space and must be constructed in accordance with tables 46 CFR 72.05-10(d) -(g)). Self closing A-Class doors must be installed at all levels in addition to the elevator cab doors. Finally, all materials fitted in the elevator cab must be approved non-combustible materials.

Aboard tank vessels which have machinery spaces of category "A", A-60 Class insulation of the machinery spaces is required. If an elevator shaft penetrates such a boundary, the entire shaft need not be insulated to A-60 Class standards, provided the machinery space insulation is installed on the underside of the deck and is carried twelve inches along the shaft.

3.6 General Design Considerations

In previous sections, the various components of the structural fire protection “Life Safety System” have been individually discussed in detail. It now remains to examine these components from a systems viewpoint - to point out areas where past experience has shown that variation from the requirements will produce an equivalent degree of safety. It is also necessary to develop recommendations for some specific applications not addressed by the regulations.

A function of structural fire protection within accommodations and service areas is to provide a separation between areas of varying fire hazard. A major degree of separation must always be provided between high hazard spaces, such as cargo holds or machinery spaces, and acclamations areas. secondly, adequate means of escape must be provided to permit trapped personnel to safely exit from untenable areas during periods of fire exposure.

Additional precautions are necessary to insure that the spread of fire is not propagated in concealed areas or in shafts or trunks which interconnect several areas.

Potential fire hazards within accommodations and service areas should be located as remote from sleeping areas as practicable. Such hazards include emergency generator rooms, galleys, or paint lockers or other areas. Normally, the boundary bulkheads and decks of all such spaces within the accommodation areas are A-Class. The only exceptions to these are small service lockers, lounges, and mess areas. (Small service lockers are regarded as any locker with less than 50 square feet of floor area, not having provisions for the stowage of flammable liquids.)

Many times mess areas are located adjacent to galleys. The bulkhead separating these two areas is required to be A-Class. If a galley serving window is installed in this bulkhead, it must be capable of meeting A-Class requirements. Normally, a rolling steel fire door, operable from outside the galley or mess area, and which is rated for 1-1/2 hours or more (NFPA 252, UL 10(b)) is acceptable. Alternatively, the galley and mess area may both be surrounded by A-Class bulkheads and doors, and appropriate fire dampers included in the ventilation system.

Refrigerated Spaces

Aboard cargo and tank vessels, reefer spaces which are contiguous with accommodations and service areas are considered as being within those areas. The regulations therefore specify non-combustible thermal insulation. Aboard passenger vessels, combustible insulations are permitted by 46 CFR 72.05-40; however, a reefer space which is a type 9 space must be separated from type 5.6, or 7 spaces by A-Class bulkheads. It is therefore felt that aboard cargo and tank vessels, combustible reefer insulations may be used if the compartment is separated from the remainder of the accommodations by A-Class bulkheads and doors.

Fan Rooms

Pan rooms within accommodation and service areas which contain an aggregate horsepower greater than 10 hp are considered high hazard areas and should be surrounded by A-Class bulkheads and decks. These fan rooms are not necessarily considered hazardous because of the machinery installed, but because of the potential area of service. Fan rooms of greater than 10 hp could service a large accommodations area, and could provide an avenue for extensive fire and smoke spread.

Combustible Materials within Concealed Spaces

As previously mentioned, the spread of flame in concealed areas is a matter of great concern. The current regulations prohibit the installation of any materials which are not approved materials in concealed spaces. This prevents the use of plastic piping and ductwork. Exemptions from this requirement, however, have been permitted. Approved electrical wiring which meets the provisions of the fire test in IEEE standard 45 is acceptable because there are few practical non-combustible wiring insulations. Additionally, other widely spaced, small amounts of combustible materials can be accepted on a case-by-case basis. Materials such as sound-deadening inserts on pipe hangers, figure 3.6.1, plastic cable ties, figure 3.6.2, and plastic shrink-fitting joint seals on ductwork have been accepted. However, the use of combustible materials in such areas must be kept to a minimum and should be discouraged. In no case should combustible interior finishes be installed in concealed spaces.

4.0 Special Service Passenger Vessels

4.1 Ferry Vessels

Ferry vessels are a unique form of passenger vessel in that they usually carry vehicles, generally do not have overnight accommodations, and are, in most cases, dedicated to specific routes of fairly short duration and high passenger density. Structural fire protection for these vessels is important because of the large number of passengers that are carried in relation to the vessel's size. If vehicles are carried, added precautions are considered necessary to provide an effective structural fire protection boundary between the vehicle and passenger areas. Passenger ferry vessels over 100 gross tons are required to comply with the structural fire protection regulations in 46 CFR Subchapter N (Passenger Vessels). Ferry vessels of 100 gross tons and less which carry more than 150 passenger! are required to comply with the same requirements as determined by the cognizant OCMI.

Because "any ferry vessels are different in design than traditional passenger vessels, it is necessary to examine the structural fire protection requirements and determine their applicability to specific ferry vessel arrangements.

The following definitions have been developed to clarify the technology used in the regulations:

- (1) Spaces specially suitable for vehicles - These are spaces which are designed for the carriage of automobiles or other self-propelled vehicles with connected batteries and fuel tanks containing gasoline on ocean or unlimited coastwise voyages. It is generally intended that these spaces are below deck and are inaccessible during the voyage; however, any such as above the weatherdeck enclosed on four sides with an overhead is also considered a space specially suitable for vehicles (type 11 space)
- (2) Vehicular Deck - These are spaces which are designed for the carriage of automobiles or other self-propelled vehicles which (1) are above the weatherdeck, (2) are not enclosed on four sides, or (3) which do not have a total overhead deck, such as a partial overhead. They may or may not be accessible to passengers during the voyage (type 11 space if inaccessible, type 7 space if accessible)

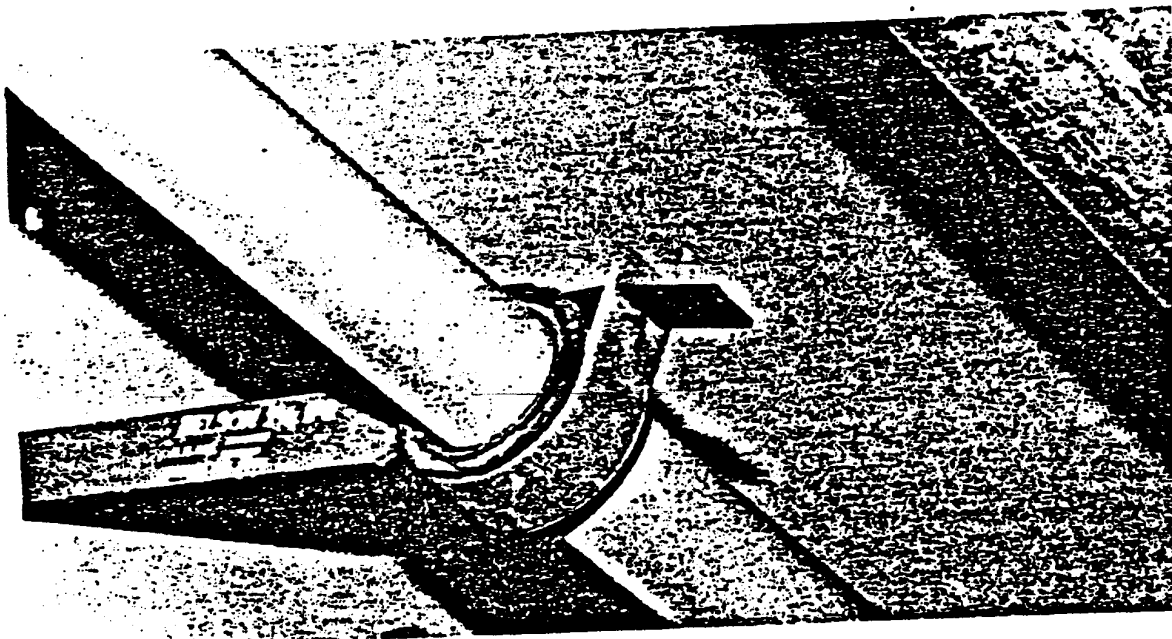


Figure 3.6.1-Plastic Sound Deadening Insert on Pipe Hanger.

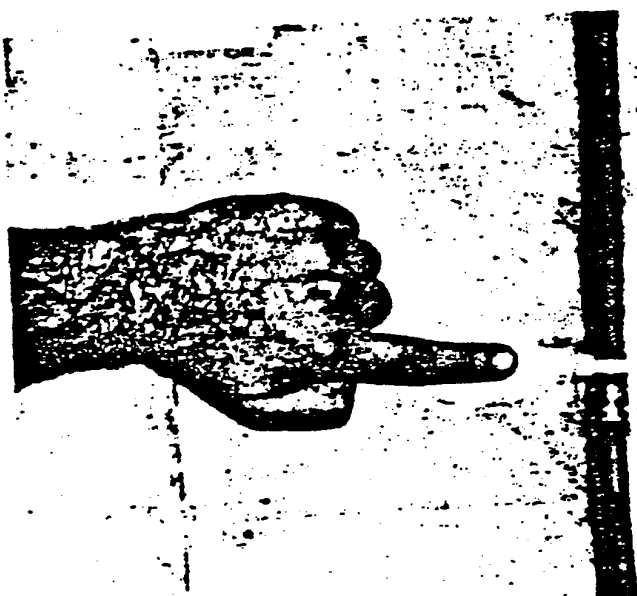


Figure 3.6.2-Widely Spaced Plastic Cable Ties.

Main Vertical Zones

Perry vessels over 131 ft. in length which are built to the requirements of ~6 ~ subchapter N must be subdivided by main vertical zones. This requirement is unrealistic for the protection of vehicle decks. To provide an equivalent degree of protection as main vertical zone bulkheads, both the vehicle deck and the deck above are designated as main vertical zone decks and must comply with the construction requirements of table 46 CFR 72.05-10(f). An additional consideration for accessible vehicle decks concerns the available means of escape. In order to comply with the intent of 46 CFR 72.05-20(f), stairtowers may not give direct access to vehicle decks, but should communicate with a corridor or foyer onto the vehicle deck. In lieu of this requirement, double doors may be provided on the stairtower exits.

Canopies and Solariums

A number of ferry vessel designs incorporate an observation area on the uppermost deck. Such an arrangement is acceptable under the scope of the current passenger vessel regulations within certain limitations. Normally, if any spot on a canopy is over 15 feet from the nearest permanent opening to the weather, the deck area is considered an enclosed space and, as such, must be constructed of noncombustible materials. If it can be assured that the permanent fuel load in such a space is .5 lb/ft² or less and two means of escape are readily available, the use of combustible materials such as plexiglas for the canopy could be acceptable as an alternative.

4.2 Dynamically Supported Craft

Dynamically-supported craft, by their very nature, are different from a displacement-type vessel. This is seen in the use of the principles of aircraft dynamics in the design and the use of relatively short routes catering to passengers desiring shorter travel times. These parameters result in a craft that is unique from the point of view of applying structural fire protection regulations which have been developed for displacement-type hulls.

Coast Guard fire protection requirements for hydrofoils and hovercraft have been developed on the principle that a level of safety equivalent to that normally expected on ships complying with Coast Guard rules and the International Convention for Safety of Life at Sea (SOXAS) can be achieved, provided that all aspects of construction, operation, maintenance, and supervision are regulated. This provides for placement of appropriate restrictions on the length and of the route of service, the sea state suitable for operation, communication facilities, reasonable proximity to a place of refuge, and the availability of rescue services.

To date, requirements for structural fire protection aboard hovercraft and hydrofoils have been determined by applying sections of 46 CFR subchapter H on a case-by-case basis. These regulations are intended for large, oceangoing vessels, with the philosophy that, until a fire reaches a stage of near-total involvement, the vessel serves as a safe refuge for all persons aboard. Some of the principles included in this traditional approach to structural fire protection include;

- (1) Division of the ship into main vertical zones;
- (2) Containment and extinction of any fire in the space of origin; and
- (3) Protection of means of escape or access for firefighting purposes.

A re-examination of these requirements, when applied to hovercraft and hydrofoils, indicates that such an approach may not necessarily produce an equivalent degree of safety without seriously impairing the operational concepts of these types of vessels. Because of their intended coastwise service, hydrofoils generally carry a large number of seated passengers, with no overnight accommodations. Such an arrangement offers limited areas of refuge. If a fire were to occur, evacuation of passengers would be required shortly after fire fighting efforts were begun. One acceptable structural fire protection philosophy for hydrofoils and similar vessels is based upon the concept of providing sufficient fire endurance time to allow evacuation of the craft, while restricting all furniture and furnishings to those of low flame spread or low fire risk. Such an approach may be considered acceptable, dependent upon the general passenger-carrying procedures followed aboard such types of craft. For example; many such vessels are divided into a number of passenger salons with attendants, in each, and the craft is in frequent radio contact with the home port. Any outbreak of fire would be rapidly detected, and the passengers evacuated with the knowledge that rescue vessels will arrive in a reasonable time period. The crew is then free to attempt extinguishment of the fire, while awaiting for rescue.

The use of traditional structural fire protection materials and requirements aboard high-speed craft could be unnecessarily weight restrictive. Trade-offs can therefore be made to provide an equivalent degree of fire protection capability for the specific service intended. The fire protection regulations in 46 CFR subchapter H (Passenger Vessels) require specific fire-endurance ratings for all bulkheads and decks. These regulations are based upon the consideration that a passenger vessel will be an oceangoing vessel and its own best lifeboat, and that attempts will be made by the crew to extinguish any outbreaks of fire prior to abandonment of the ship. Greater fire-endurance properties of bulkheads and decks are therefore needed to provide areas of refuge for the passengers and crew.

The philosophy of structural fire protection which has been applied to hydrofoils on a case-by-case basis, considers the vessel as being divided into three major areas:

- (1) machinery spaces;
- (2) control stations; and
- (3) passenger areas.

Depending on arrangement, specified structural fire protection measures may be required only for the bulkheads and decks which separate these three major areas. A-30 Class bulkheads and decks are recommended as a minimum for these divisions. Another factor influencing the need for structural insulation is the use of aluminum. While no insulation may be required between two passenger decks, means must be provided to prevent the collapse of overhead decks during periods of fire exposure. This generally requires some form of insulation on stanchions or other aluminum structural members.

Another element of the structural fire protection system for hydrofoils concerns furniture and furnishings. To prevent rapid flame spread in passenger areas, materials which exhibit low flame spread and smoke emission characteristics may be required. The requirements which have been utilized thus far are even more stringent than the requirements for fire resistant furnishings. The following test requirements have been previously accepted:

- (1) Seat cushions must pass the ASTM 3162-76 Radiant Panel Test with a flame propagation index not exceeding 25. No specimen flaming runnings or drippings may occur during testing. Wire mesh screening must be used as per Section 5.9.2

of the test. A 6 inch long pilot flame must be provided. The burner tip must be situated 1 ¼ inches beyond the frame to prevent extinguishment. Aluminum foil must be used as wrapping around the back sides of the specimen.

By additional test or analysis, the fire resistant properties of seat cushion material must be shown to be an integral part of the material.

- (2) Interior textiles must be tested in accordance with the procedures in Appendix F to 46 CFR 25. The following criteria apply in conducting these tests:
 - (a) The average flame time after removal of the flame source must not exceed 10 seconds.
 - (b) Burn length must not exceed 2.5 inches.
 - (c) Drippings from the test specimen must not flame.

Fabrics that must be machine washed or dry cleaned must meet the criteria in paragraphs 3 (i) (ii), and (iii) above after leaching in accordance with Federal Test Method Standard 191b, Method 5930, or after dry cleaning in accordance with AATCC-86-1966.

Fabrics that cannot be machine washed or dry cleaned must be so labeled and pass the leaching test in FTM Standard 191b, Method 5830, and must meet the test criteria in paragraphs B (i), (ii), and (iii) above after being cleaned as recommended by the manufacturer.

- (3) carpeting must be tested with its padding if the latter is to be used, and must be capable of passing the NBS Flooring Radiant Panel Test (NFPA 253-1978) with a minimum critical radiant flux of 0.6 watts/cm².
- (4) Interior textiles and carpeting must also be tested for smoke emission in accordance with NFPA 258-1976 "Test Method for Measuring the Smoke Generation by Solid Materials". When conducting this test, the optical density, D, in both flaming and non-flaming modes must be determined and may not exceed 100. until at least 4 minutes after start of the test.

5.0 Tank Vessels

Additional structural fire protection measures are required aboard tank vessels to protect the deckhouse or other accommodation spaces adjacent to the cargo area from deck fires. Actual experience has shown that a deck fire of extreme duration and intensity is possible aboard a tank vessel. In the event that such a fire were to occur, it is imperative that the deckhouse be adequately protected to allow the crew a safe refuge and coordination area for firefighting activities.

The Coast Guard design approach provides an A-60 Class barrier on the deckhouse or superstructure. (This requirement does not apply to forecabin spaces containing only isolated storage spaces. Isolated storage spaces do not contain accommodation or control spaces. Therefore, 46 CFR 32.56-20 and 46 CFR 32.56-21 are not applicable.)

No openings leading to accommodation service or control spaces are permitted in the deckhouse. With the exception of the navigation bridge, all portlights must be of fixed or non-opening types with 11 USSG

minimum steel covers operable from the interior. These requirements are applied to the boundaries facing the cargo area as well as the side of the deckhouse or superstructure for several feet aft, depending on the type of tank vessel. Further details are contained in the regulations as follows:

- (a) Subchapter D - 46 CYR 30-40 "Tank Vessels";
- (b) Subchapter O - 46 CFR 153 "Safety Rules for Self-propelled Vessels carrying Hazardous Materials";
- (c) Subchapter O - 46 CFR 154 "Safety Standards for Self-propelled Vessels carrying Bulk Liquefied Gases; Special Interim Regulations for Issuance of Letters of Compliance to Barges and Existing Liquefied Gas Vessels."

6.0 Aluminum Construction

The information contained in the Society of Naval Architects and Marine Engineers' Technical and Research Bulletin 2-21 is a listing of acceptable methods of insulating aluminum bulkheads and decks to achieve the fire endurance required by Coast Guard regulations. This bulletin is a result of full scale tests, developed by the Fire Test Method Subgroup Task Group HS-6-1 (Aluminum) of the Hull Structure Committee. Inasmuch as this report was prepared under joint Coast Guard sponsorship, it is acceptable guidance for the review and planning of aluminum construction methods for bulkhead and deck assemblies. Additional structural fire protection considerations such as penetration protection and arrangement details are contained in this section.

Aluminum construction is considered acceptable for internal divisions within accommodations services and control spaces on all vessels with the following exceptions:

- (1) category A machinery space boundaries including trunks must be steel.
- (2) Except for C-class divisions, aluminum construction may not be used aboard tank vessels.
- (3) Total aluminum construction will be permitted for small passenger (46 CFR subchapter T) and oceanographic (subchapter U) vessels.
- (4) Aluminum superstructures may be utilized on cargo and miscellaneous (Subchapter I) and passenger (Subchapter H) vessels.

The use of aluminum in other areas is subject to special consideration.

Methods for insulating aluminum construction differ from those for steel assemblies for several basic reasons. When considering either steel or aluminum, one hour is the longest period of time any assembly is required to maintain its integrity under fire conditions. By examining the standard time-temperature curve (the standard by which insulation assemblies are evaluated) we find that after one hour, the expected temperature in the fire zone is in the range of 1700°F. For steel bulkheads and decks, this temperature is below the melting point of the steel; thus, if a fire should occur on either side of a steel partition, structural integrity will be maintained. Structural insulations, if required, need be installed on only one side of a steel division. For aluminum however, a different situation exists. To maintain its structural integrity under fire conditions for more than several minutes, the aluminum must be insulated to keep the aluminum core temperature below 450°F (232°C). Although the melting point is much higher, failure of aluminum plating under loaded conditions may occur at this temperature.

Since it cannot be predetermined from which side fire exposure will occur, insulation must be applied to the aluminum so that it will be sufficiently protected to withstand a 1-hour fire exposure from either side, except in cases where exposure from only one side is possible. In addition, extra structural insulation must be installed to limit the heat transfer through the assembly to maintain specified temperatures on the unexposed side of the assembly where required. This additional insulation must be applied in a specific manner. Extra insulation may actually decrease the fire endurance of the assembly.

An 11 USSG steel plate without insulation is rated as A-O Class; however, an aluminum plate (minimum thickness of 3/16") must have an insulation value (F_c) of 72 S to be rated as A-O. The A-O Class steel plate can be changed to A-15, A-30 or A-60 Class by adding some pre-determined thickness of approved structural insulation, but the aluminum A-O Class assembly, which already includes some amount of structural insulation, cannot be changed to A-15, A-30 Class, or A-60 by the same process. On pages 6 and 7 of SNAME Bulletin 2-21, an explanation is given detailing how the insulating value of an aluminum assembly is affected by increasing the amount of applied structural insulation. Depending upon the configuration of the insulation and aluminum plate, the insulating value of the assembly may increase or decrease. As a result, bulkhead and deck assemblies can be constructed which will have different fire-endurance capability, depending upon which side of the assembly is exposed to fire. Appendix C of SNAME Bulletin 2-21 depicts a variety of bulkhead and deck assemblies, showing the total insulating value of the assembly (F_t), and the core insulating value (P_c) provided by the insulation on each side of the aluminum plate. Simply stated, the (P_c) value determines whether the assembly is A-, B-, or C-class, and the (F_t) value determines whether the assembly can be rated A-0, A-15, A-30, or A-60 Class.

When planning aluminum construction, formidable amounts of insulation may be required to comply with the current regulations for structural fire protection. For example, consider that a common bulkhead separating two spaces is required to be A-60 Class. If it cannot be positively stated whether the likelihood of fire is greater in one space or the other, A-60 Class capability must be provided on both sides of the bulkhead. This degree of protection may not be necessary in all cases, and the following alternative approach could be used on a case-by-case basis. If, by using the fire loading survey technique explained on pages 10 through 15 of SNAME Bulletin 2-21, it can be determined that the fire loading of the two spaces is insufficient to warrant A-60 Class protection on both sides of the bulkhead, a lower insulation value may be used on one side. To maintain the intent of the regulations, one side of the bulkhead should still be insulated to A-60 standards. The various subchapters of 46 CFR should be consulted to determine the amount of fire endurance necessary for each bulkhead and deck. A fire loading study can then be made. The required degree of insulation is then installed on the side of the bulkhead or deck facing the space with the more severe fire loading. The insulation value for the remaining side of the assembly is then calculated, based on the lower fire loading of that space. Several exceptions to this method are noted as follows:

- (1) For certain spaces, it is desirable to provide insulation to prevent the spread of fire into the space. Such spaces include control stations, spaces containing fire extinguishing equipment, escape routes and spaces adjoining machinery spaces, and emergency generator and battery rooms. For these spaces, the degree of protection required by the regulations should be on the exterior boundary of the space. The interior side insulation value is then based on the fire loading inside the special category space.
- (2) The underside of all decks, except weatherdecks, should be insulated to a minimum A-0 Class requirement.
- (3) Bulkheads and decks separating water tanks, void spaces, and ballast tanks from open deck areas need not be insulated. Fuel tank boundaries should be insulated only on the external

side. Fuel tank boundaries should meet a minimum A-0 requirement and should be increased accordingly, depending upon the fire loading of the adjacent space.

- (4) The overhead and sides of non load-bearing canopy decks, that serve only as protection from the elements, do not require insulation. If the overhead of such a canopy deck supports a load such as lifesaving equipment, passengers etc., the overhead, sides, and supporting structure should be insulated in accordance with the following table:

<u>Fire Load</u>	<u>F_C Value</u>
less than 0.5	0
0.5 to 1.99	0.25 s
2.0 to 4.99	0.45 s
4.5 to 6.99	0.61 s
7.0 and greater	0.72 s

- (5) Bulkheads and decks separating passenger spaces and open spaces (not safety areas) should be insulated on the internal side in accordance with the above table.
- (6) Shell plating and framing below the main deck should be insulated to A-0 Class standards for a distance at least 12 inches below the lightship waterline. Voids or other spaces with a fire load of .51b/ft² or less need not be insulated.
- (7) Insulation in machinery spaces or other spaces where oil fuel is used should be provided with a vapor barrier, and should not extend into the bilge area where it could become oil soaked.

Care should be taken in applying materials other than those required. Additional approved bulkhead panels, structural insulations, deck coverings, or noncombustible material, may not be used without restriction, because their use may actually decrease the fire endurance of the assembly.

Aluminum Bulkhead and Deck Penetrations

As with steel bulkheads and decks, penetrations of aluminum bulkheads and decks must be sealed to maintain the integrity of the division. Where the penetration is made by aluminum pipe or ducting, etc., similar methods may be employed as for steel. ~ difficulty arises when ferrous or other non-aluminum materials penetrate aluminum divisions. Because of corrosion problems due to the contact of dissimilar metals, a means of isolation must be provided between the steel penetration and the aluminum divisions. This insulating material must be carefully evaluated in regard to its fire endurance. Depending upon the arrangement of the penetration, trade offs may be made on a case-by-case basis to insure an acceptable method.

7.0 Structural Fire Protection Review Procedures

- (1) Determine the applicable regulations - Table 3.0 is a ready reference of where to look within the following regulations:

46 CFR 32.57 - Tank Vessels

46 CFR 72.05 - Passenger Vessels

46 CFR 92.05 - Cargo & Miscellaneous Vessels

46 CFR 72.05 - Small Passenger Vessels which carry over 150 passengers

46 CFR 177.05- Small Passenger Vessels which carry less than 150 passengers

- (2) Determine if the vessel will be steel or aluminum. If aluminum, see Section 6 before proceeding.
- (3) Review the proposed materials list to determine if approved materials are provided. Consult CG-190 or approved equipment card file for approval numbers

164.006/X - Dock coverings

164.007/X - Structural insulation

164.008/X - Bulkhead panels

164.009/X - Non-combustible materials

164.012/X - Interior finish materials

164.035/X - Fire retardant resins

Non-approved materials should be rejected, or Commandant (G-MMT-3) (tel. 202-426-1444) should be consulted to determine acceptability of alternate materials.

“Fire-Resistant” materials do not have a type approval. Test data from UL or other independent laboratories should be submitted to verify the materials ability to pass the following tests:

Fire Resistant Fabric - 46 CFR 164.011 or NFPA 701 (large & small tests)

Fire Resistant Cushions - ASTM - D1692 (self-extinguishing or extent of burning (less than 5 inches)

Wool or equivalent carpets and underpads - ASTM E-84, Flamespread less than 75, smoke developed less than 100

Review general arrangement plan for use of non-combustible materials within accommodations and service areas. The following are required to be non-combustible:

- bulkheads and decks
- doors, frames, related hardware
- stairs
- ceilings
- linings and draft stops
- insulations (see Sec. 3.6 on Reefers)

- duct and pipe laggings
- trim, veneers, decorations, etc. in corridors, stairways or hidden spaces

- room dividers or partial bulkheads
- all materials which are used to secure any of the above

NOTE: Type approved materials are non-combustible. Approved deck coverings and approved interior finish material are determined to have an acceptable level of combustibility when installed in approved locations and thickness.

- Review general arrangement plan to determine if bulkhead and deck classifications are acceptable. (e.g., stairtower A-0, machinery space casing - A-60, etc.). Requirements are found in construction and arrangement regulations determined in step 1.
- Review each type bulkhead and deck to determine if the required fire endurance (A-0, A-60, etc.) can be achieved with the insulating scheme proposed. Sketches of tested bulkhead insulating methods are in section 3e 1. Sketches of tested deck assemblies are in Section 3.2. Any other arrangements cannot be accepted without specific approval of Commandant (G-MMT-3) (tel. 202-426-1444) or Commandant (G-MMT-4) (202-426-2197).
- Check proposed installation method of approved structural insulations (164.007). Mechanical steel fasteners must be used. Spacing of fasteners must be limited as specified in section 3.1. Insulation should wrap around corners twelve inches to prevent heat transfer. Penetration of insulated bulkheads and decks must be insulated for twelve inches along penetration.
- Check proposed installation method for bulkhead panels. Joiner work system must be identical to that on approved plans. All connectors must be steel.

NOTE: Approved joinerwork plans are kept on file in conjunction with approval card. Details are in Section 3.2.

- Check installation of draft stops in void spaces between bulkhead panels and steel bulkheads and decks. (Required for passenger and tank vessels.)
- Check proposed deck coverings. Approved 164.006 materials must be used in specified thickness. Where latex or other mastics are used to bond the deck covering to the deck, it must be noted on the approval card. 3/8" thickness overlay of any material is permitted.
- Determine if rugs and carpets must be "wool or equivalent". See Section 3.2 and regulation in step 1.
- Check interior finish materials. 2 1/8" thickness of any material is permitted on bulkheads, linings and ceilings except in corridors, stairways and hidden spaces. Where 164.012 materials are required, adhesives or other fasteners must be as noted on the approval card.
- Check penetration details of all piping, wiring and ductwork. Steel A-Class bulkheads and decks must be positively sealed to prevent passage of smoke and flame. 3-Class bulkhead penetration must be as tight as possible.
- Check ventilation drawings to determine if fire dampers are provided at bulkhead and deck penetration. Thickness of steel and routing of duct must be considered. See Section 3.4.
- Check construction of doors and frames Louvers may be installed in B-Class doors.

- Check windows and portlight construction. Wire inserted glass and steel covers may be required. Steel retaining clips are required on aluminum frames.
- Check furniture and furnishings of each space.
- Determine if two means of escape are available from each area.
- Check stairways to determine if stair towers should be provided.
- Check tonnage openings. Steel tonnage openings are required in A-Class bulkheads.
- Review regulations determined in Step 1 to ascertain if any additional requirements exist.